Dynasonics®

DXN™

Portable Ultrasonic Measurement System

DXN™ Users Instructions

Badger Meter

06-HYB-UM-00010 (June 2012)
Software Rev E

Installation & Operation Manual

Dynasonics®

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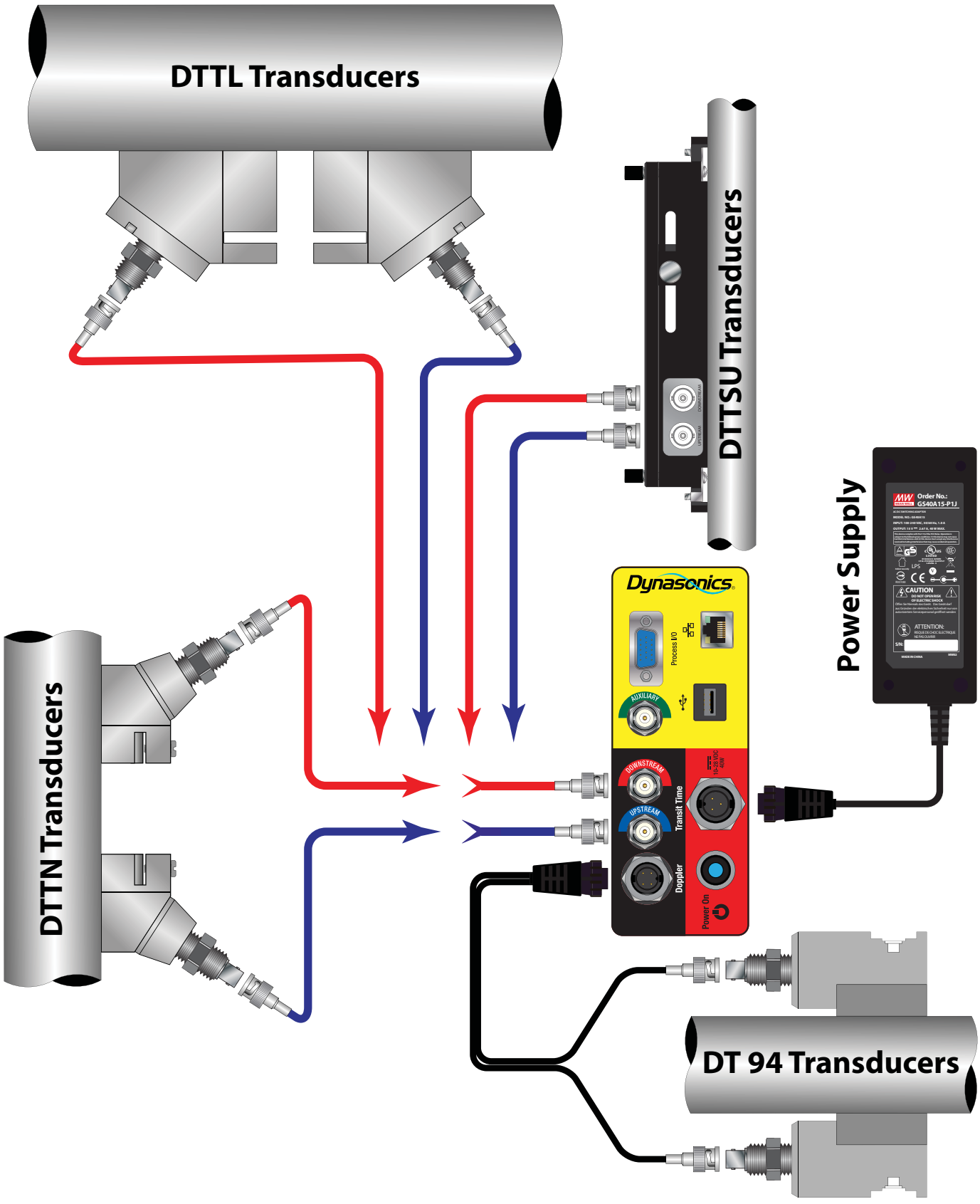


DXN Transducer - Connection Diagram

QUICK-START OPERATING INSTRUCTIONS

WARNING **Warning:** Not following the instructions properly may impair safety of equipment and/or personnel.

CAUTION **Caution:** If the DXN is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired."

This manual contains detailed operating instructions for all aspects of the DXN instrument. The following condensed instructions are provided to assist the operator in getting the instrument started up and running as quickly as possible. This pertains to basic operation only. If specific instrument features are to be used or if the installer is unfamiliar with this type of instrument, refer to the appropriate section in the manual for complete details.

TRANSDUCER LOCATION

1) In general, select a mounting location on the piping system with a minimum of **10** pipe diameters (10 × the pipe inside diameter) of straight pipe upstream and **5** straight diameters downstream. See ***Table Q.1*** for additional configurations.
2) If the application requires DTTN or DTTL transit time transducers select a mounting method for the transducers based on pipe size and liquid characteristics. See ***Table 3.8***. Transit time transducer configurations are illustrated in ***Figure Q.1*** below.

NOTE: *Transit time setups require information supplied by the DXN meter itself so it will be necessary to power on the unit, at least temporarily, to obtain the setup information.*

3) For transit time operation enter the following data into the DXN transmitter via the touchscreen software utility:

1. Transducer mounting method
2. Pipe O.D. (Outside Diameter)
3. Pipe wall thickness
4. Pipe material
7. Pipe liner thickness
8. Pipe liner material
5. Pipe sound speed*
6. Pipe relative roughness*
9. Fluid type
10. Fluid sound speed*
11. Fluid viscosity*
12. Fluid specific gravity*

* Nominal values for these parameters are included within the DXN operating system. The nominal values may be used as they appear or may be modified if the exact system values are known.

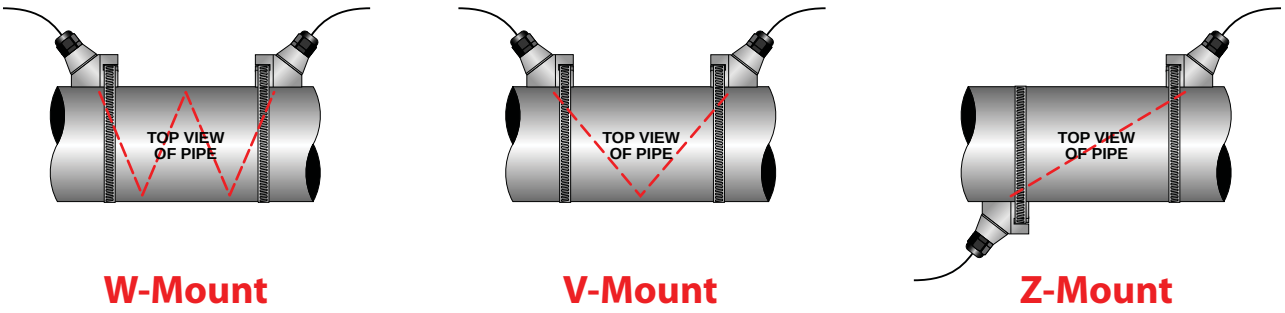


FIGURE Q.1 - TRANSIT TIME TRANSDUCER MOUNTING CONFIGURATIONS

4) Record the value calculated and displayed as **Required Spacing** in the **Site Group ► Transit Page**.

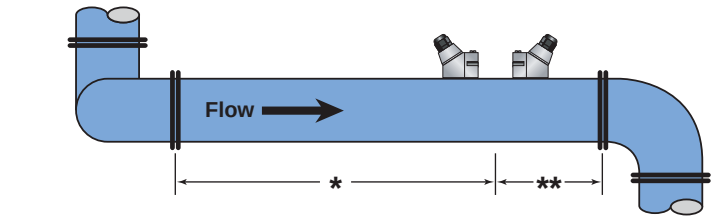
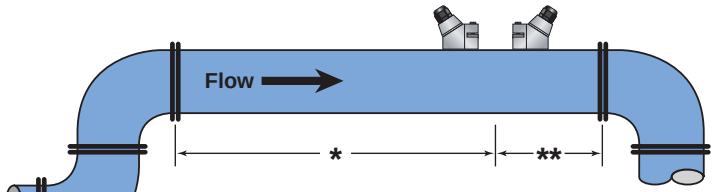
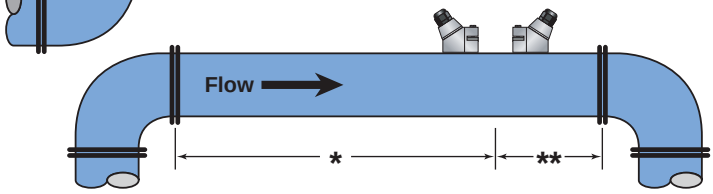
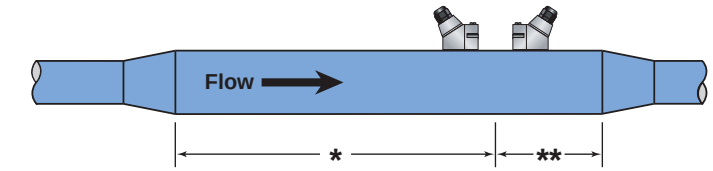
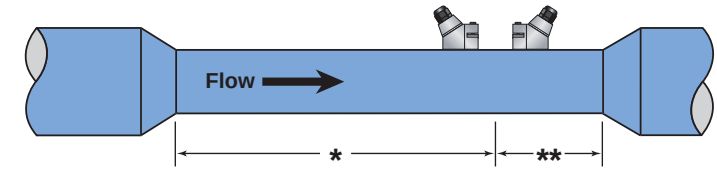
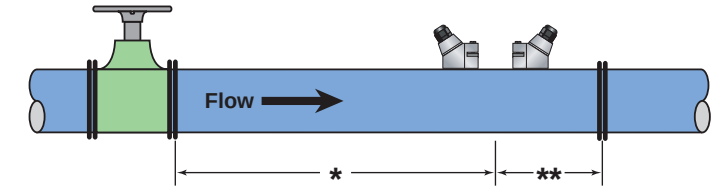
Piping Configuration and Transducer Positioning	Upstream Pipe Diameters	Downstream Pipe Diameters
	*	**
	24	5
	14	5
	10	5
	10	5
	10	5
	24	5

TABLE Q.1 - PIPING CONFIGURATION AND TRANSDUCER POSITIONING

PIPE PREPARATION AND TRANSDUCER MOUNTING

DTTN and DTTL Transit Time Transducers

1) During this procedure the flow meter's signal quality value should be observed. This value is available on the DXN **Display Group ► Meters Page** where "TT Quality" is one of the parameters that can be shown.
2) The pipe surface where the transducers are to be mounted must be clean and dry. Remove scale, rust or loose paint to ensure satisfactory acoustic conduction. Wire brushing the rough surfaces of pipes to smooth bare metal may also be useful. Plastic pipes do not require preparation other than cleaning.
3) Apply a single ½" (12 mm) wide by approximately ⅛" thick bead of acoustic couplant grease to the upstream transducer and secure it to the pipe with a mounting strap.
4) Apply acoustic couplant grease to the downstream transducer and press it onto the pipe using hand pressure at the calculated lineal distance.
5) Space the transducers according to the recommended values found during programming. Secure the transducers with the mounting straps at these locations.

DTTSU Universal Small Pipe Transit Time Transducers

1) During this procedure the flow meter's signal quality value should be observed. This value is available on the DXN **Display Group ► Meters Page** where "TT Quality" is one of the parameters that can be shown.
2) The pipe surface where the transducers are to be mounted must be clean and dry. Remove scale, rust or loose paint to ensure satisfactory acoustic conduction. Wire brushing the rough surfaces of pipes to smooth bare metal may also be useful. Plastic pipes do not require preparation other than cleaning.
3) Set the downstream transducer spacing to the value found on the **Site Group ► Transit Page**.
4) Apply a single ½" (12 mm) wide by approximately ⅛" thick bead of acoustic couplant grease to the face of each transducer and secure it to the pipe with attachment chains.
5) Tighten the two thumb screws evenly so that the acoustic coupling grease begins to flow out from the edges of the transducer and from the gap between the transducer and the pipe. **Do not over tighten**.

DT94 Doppler Transducers

1) In general, select a mounting location on the piping system with a minimum of 10 pipe diameters (10 × the pipe inside diameter) of straight pipe upstream and 5 straight diameters downstream. See ***Table Q.1*** for additional configurations.
2) The pipe surface, where the transducers are to be mounted, must be clean and dry. Remove scale, rust or loose paint to ensure satisfactory acoustic conduction. Wire brushing the rough surfaces of pipes to smooth bare metal may also be useful. Plastic pipes do not require preparation other than cleaning.
3) Apply a single ½" (12 mm) wide by approximately 1/8" thick bead of acoustic couplant grease to both transducers and secure them to the pipe 180° apart using a mounting strap. Ensure that the transducer cable is pointing in the downstream direction.

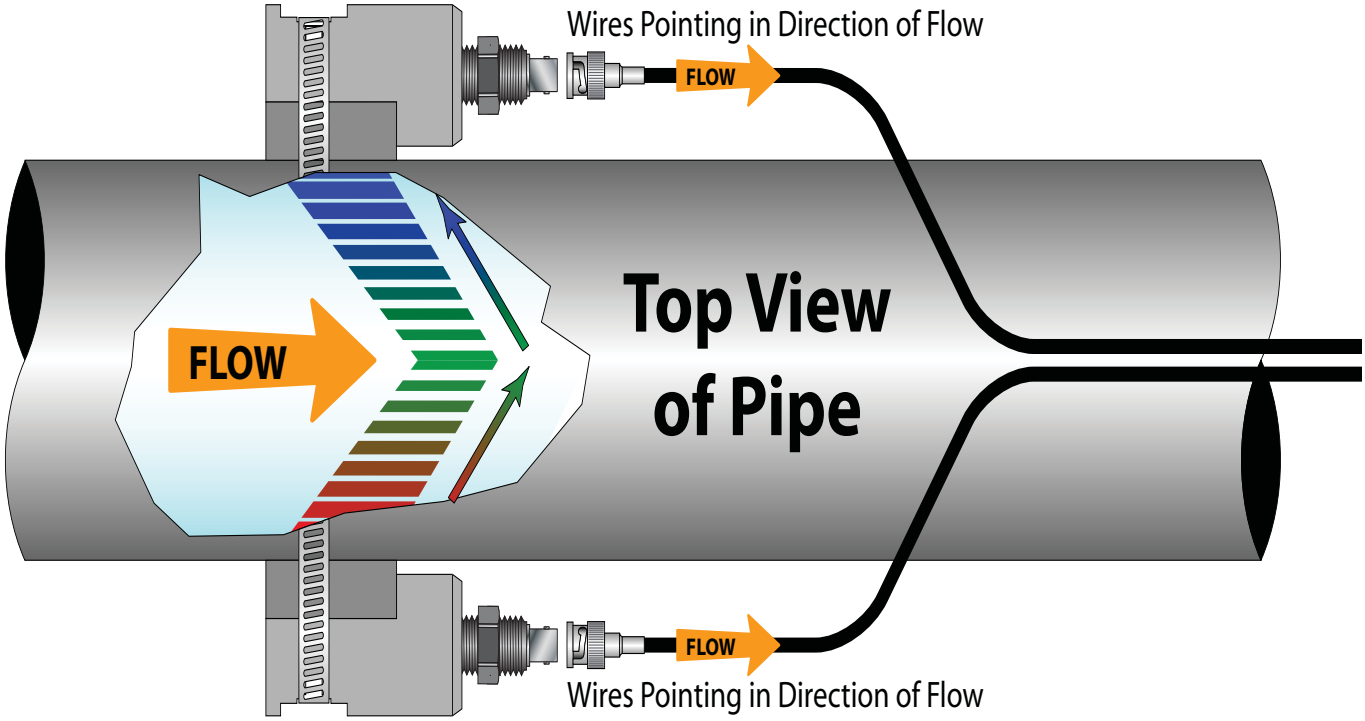


FIGURE Q.2 - DOPPLER TRANSDUCER MOUNTING

TRANSDUCER CONNECTIONS

1) Route the transducer cables from the transducer mounting location back to the DXN enclosure, avoiding locations near high voltage supply wires.
2) Connect the transit time transducer wires to the appropriate BNC or connect the Doppler transducers to the 4-pin Doppler transducer plug. Both connections are on the end of the DXN enclosure.

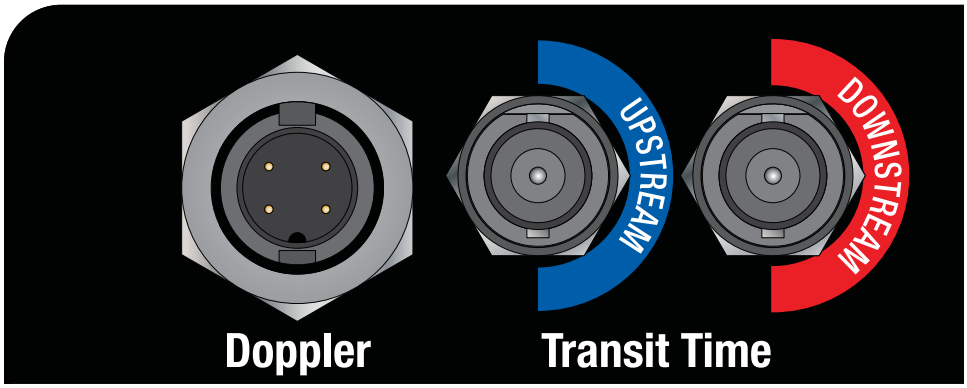


FIGURE Q.3 - TRANSDUCER CONNECTIONS

NOTE: *Transit time transducer wires go in opposite directions when DTTN or DTTL transducers are used (See* ***Figure Q.1****). DT94 Doppler transducer wires both go in the direction of flow. (See* ***Figure Q.2****)*

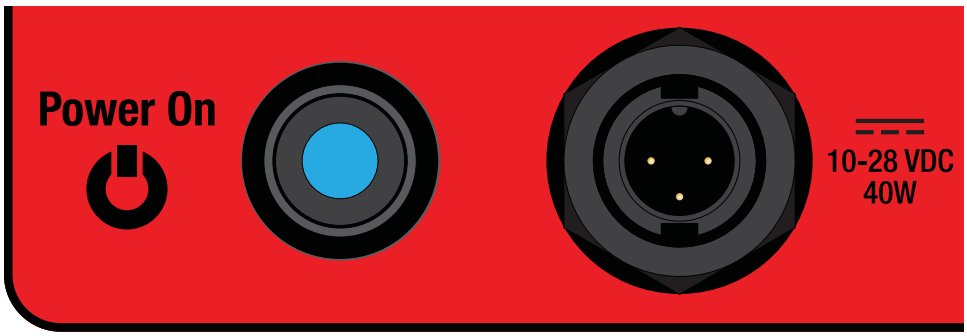


FIGURE Q.4 - POWER SWITCH AND CHARGING CONNECTION

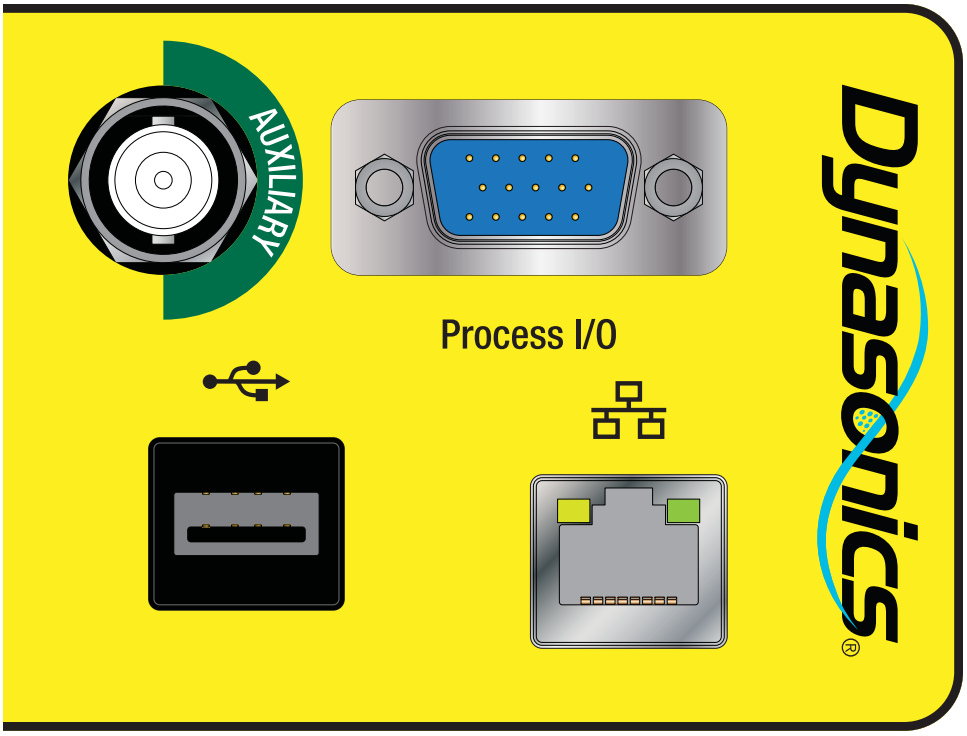


FIGURE Q.5 -THICKNESS GAGE (AUXILIARY) CONNECTION

STARTUP

INITIAL SETTINGS AND POWER UP

1) Apply power to the transmitter by pressing the "**Power On**" button.
2) Verify that **Signal Quality** is greater than 10.0 %.

1 - INTRODUCTION

GENERAL

WARNING **Warning:** Not following the instructions properly may impair safety of equipment and/or personnel.

CAUTION **Caution:** If the DXN is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired."

The DXN portable ultrasonic flow meter is designed to measure the fluid velocity of liquid within a closed conduit. The transducers are a non-contacting, clamp-on type, which will provide benefits of non-fouling operation and ease of installation.

In transit time mode the flow meter utilizes two transducers that function as both ultrasonic transmitters and receivers. The transducers are clamped on the outside of a closed pipe **at a specific distance from each other**. The transducers can be mounted in **V-**Mount where the sound transverses the pipe two times, **W-**Mount where the sound transverses the pipe four times, or in **Z-**Mount where the transducers are mounted on opposite sides of the pipe and the sound crosses the pipe once. The selection of mounting method is based on pipe and liquid characteristics, which both have an effect on how much signal is generated. The flow meter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the time interval that it takes for sound to travel between the two transducers. The difference in the time interval measured is directly related to the velocity of the liquid in the pipe.

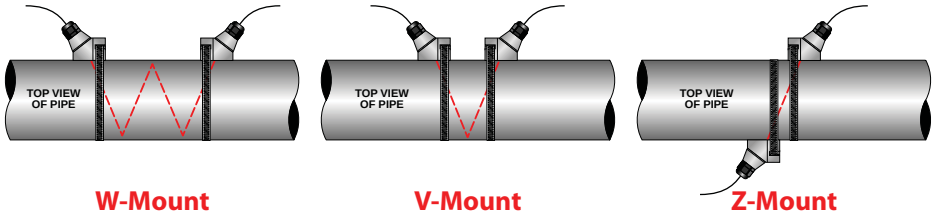


FIGURE 1.1 - ULTRASOUND PROPAGATION

APPLICATION VERSATILITY

The DXN flow meter can be successfully applied on a wide range of metering applications because the meter has both transit time and Doppler capabilities. The full range of fluids from ultrapure to thick slurries can be measured. The simple-to-program transmitter allows the standard product to be used on pipe sizes ranging from ½ inch to 100 inches (12 mm to 2540 mm)*. A wide variety of liquid applications can be accommodated.

ultrapure liquids	**cooling water**	**potable water**	**river water**
chemicals	**plant effluent**	**sewage**	**sludge**

Because the transducers are non-contacting and have no moving parts, the flow meter is not affected by system pressure, fouling or wear. Standard transducers, DTTN, DTTL and DTTSU are rated for a pipe surface temperature of -40 to +250 °F (-40 to +121 °C).

DT94 Doppler transducers have a temperature range of -40 to +212 °F (-40 to +100 °C).

*All ½" to 2" DTTSU small pipe transducers sets require the transmitter be configured for 2 MHz. DTTL transducers require the use of the 500 KHz transmission frequency. The transmission frequency is selectable using the touchscreen interface.

User Interface Features

2-Level Tabbed Menu:

- ~ Group Tabs contain a group of Page Tabs and Interface Pages
- ~ The user can navigate to Page Tabs sequentially by the Navigate Left or Navigate Right buttons
- ~ The user can activate any Group Tab or Page Tab by single finger press.
- ~ Certain Page Tabs can be pressed or double pressed for additional functionality.
- ~ Interface Page can contain meters, user entry controls, graphs, etc.

Smart Status Bars:

- ~ Status Bars contain Status Items that show and control helpful transmitter functions such as showing flow or controlling data logging.
- ~ The user can navigate Status Bars sequentially only with the Status Bar Navigation Button
- ~ Certain Status Items can be double clicked for addition functionality. Often times they can automatically navigate to a Page Tab.
- ~ Status Bars include Quickview, Power Status, Shutdown, Sensor Positioning, etc...

DATA INTEGRITY

Non-volatile flash memory retains all user-entered configuration values in memory for several years at 77 °F (25 °C), even if power is lost or turned off. Password protection is provided as part of the Security Settings **System Group► Miscellaneous Page** and prevents inadvertent configuration changes or totalizer resets.

PRODUCT IDENTIFICATION

The serial number and complete model number of the transmitter are located on the bottom surface of the transmitter's body. Should technical assistance be required, please provide the Customer Service Department with this information.

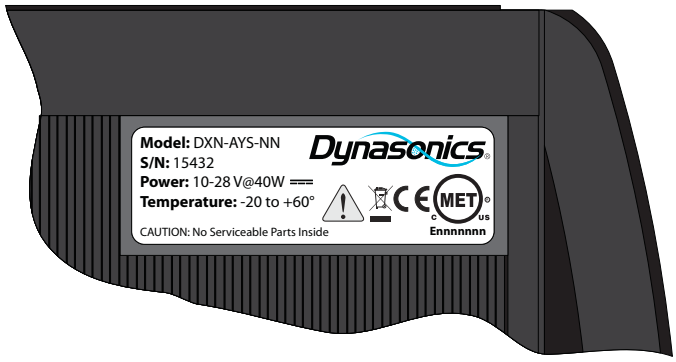


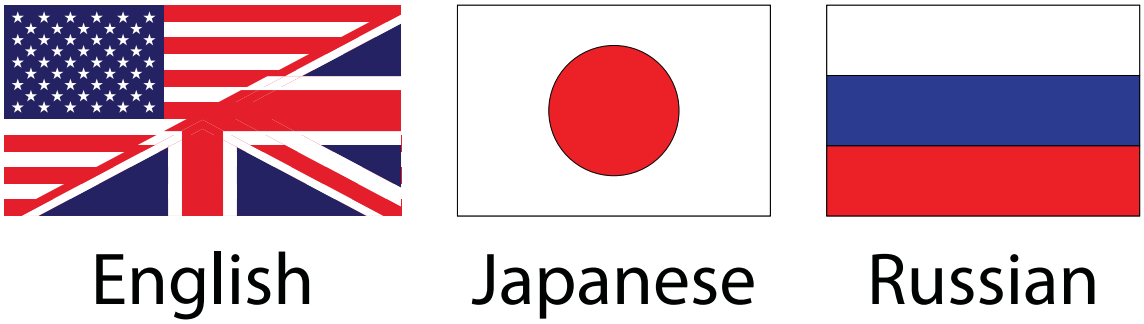
FIGURE 1.2 - SERIAL NUMBER LOCATION

CAUTION

Caution - Do not use sharp objects on the display as damage will occur.

Multilingual Support

The user interface is capable of displaying in multiple languages. Currently Japanese and Russian as well as English are available by simply pressing a button.



The language selection icons can be found in the **System Group ► Misc Page** or from the Status Bar Control (See ***Figure 4.3***)

2 - SOFTWARE CONVENTIONS

The DXN uses a sophisticated touch screen user interface to control all functions. The tabbed menu tree provides access to all controls and settings within two layers of menus. Large easy to read touchscreen buttons allow for gloved operation in inclement weather.

CONVENTIONS AND CONTROLS

When navigating the DXN menus this manual will specify first the **Group Tab** name and then the **Page** as shown below.

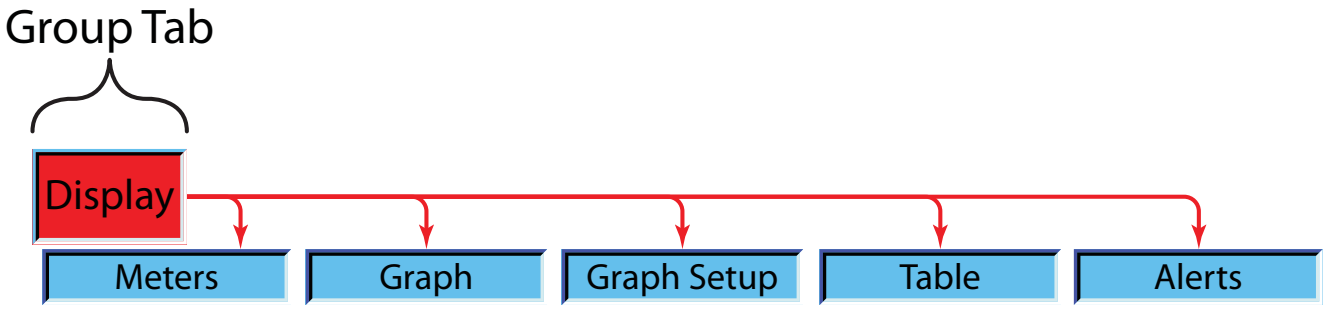


FIGURE 2.1 - GROUP/PAGE CONVENTION

A typical reference would look like the following:

Display Group ► Meters Page

Upon startup of the instrument using the back panel power button, the system will display a series of splash, progress, and information screens.

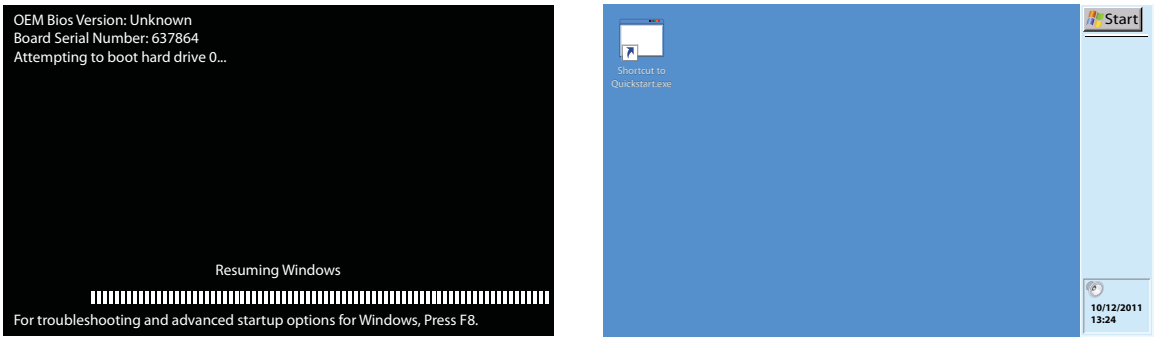


FIGURE 2.2 - STARTUP SCREEN EXAMPLES

The user screens consists of controls, status icons, and data display areas similar to most found on personal computers. Detailed description of interface functions are found throughout this manual.

DXN Data and Controls Layout

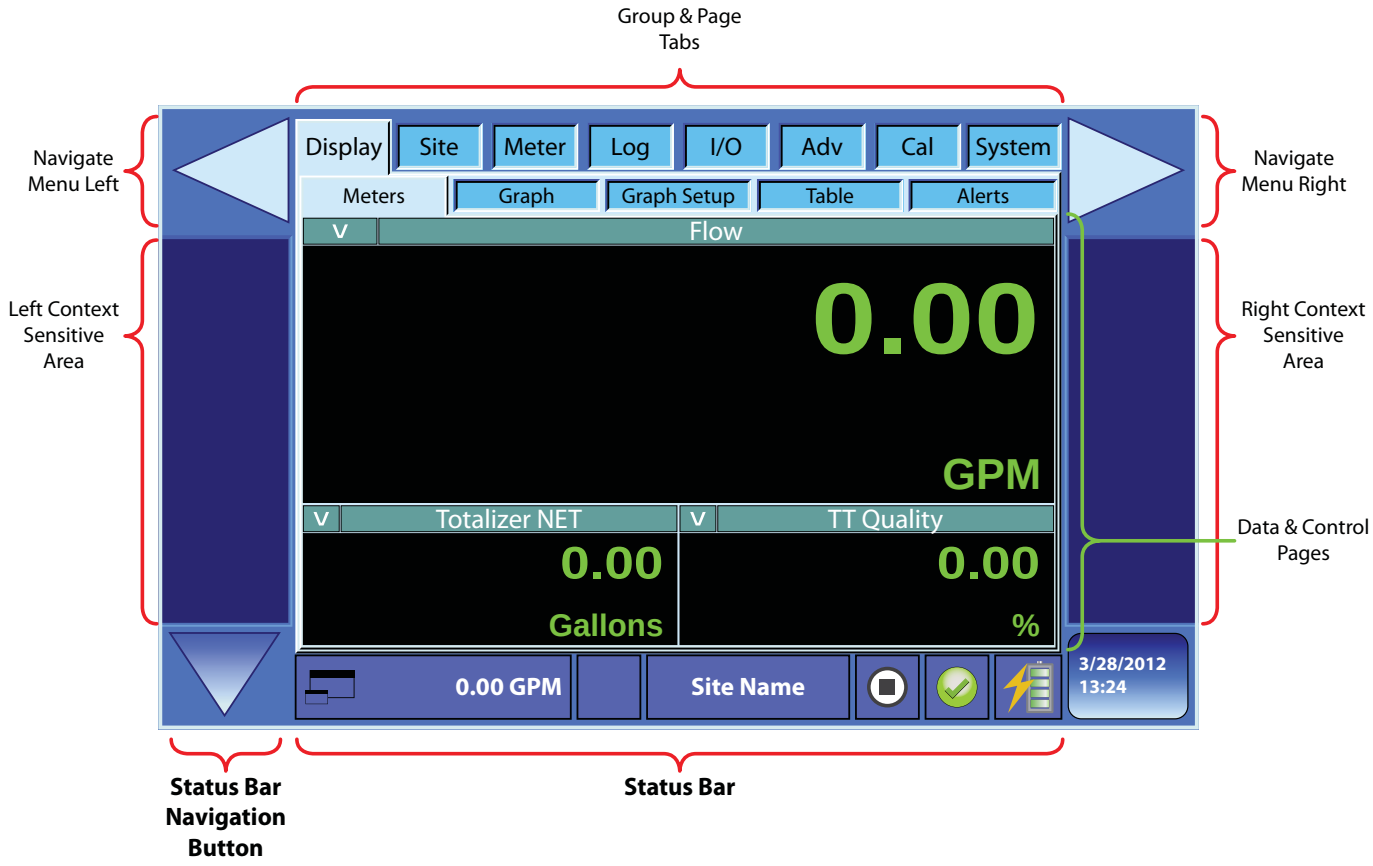


FIGURE 2.3 - MAIN USER SCREEN LAYOUT

CONTROLS

The DXN uses many of the same software controls as common windows based graphical user interfaces. The following describes the controls and how they are used.

Text Box

The text box provides space for the user to enter various pieces of data such as the "**Create New Site**" button. When the text box button is pressed a pop-up Qwerty keyboard pop's up allowing text and/or numbers to be entered.

FIGURE 2.4 - TEXT BOX

FIGURE 2.5 - ALPHA NUMERIC KEYPAD

On/Off Check Box

This control allows the user to turn on or off a function. A box with a check mark in it indicates the function is on and the function is off when the check mark is absent.

FIGURE 2.6 - CHECK BOX STATES

When an item is changed, the control will change to orange while the settings are updated.

FIGURE 2.7 - CHECK BOX TRANSITION

Buttons

Button controls work in a similar manner to a push-button switch and generally starts or stops some function.

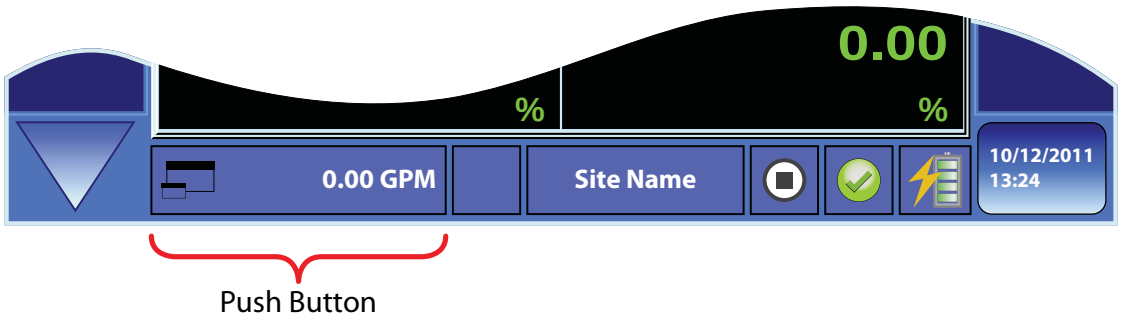


FIGURE 2.8 - PUSH BUTTON CONTROL

Shut Down Slider

The shutdown slider allows the DXN to be turned off without having to press and hold the physical On/Off button. To use the shutdown slider simply touch the red button on the left hand side of the screen and drag it to the right until it snaps to the right hand screen stop.

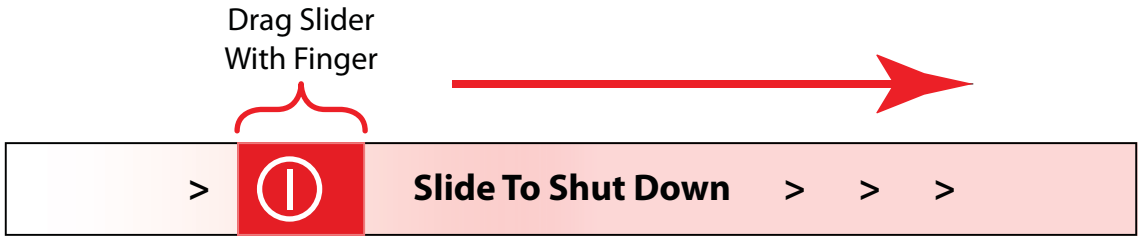


FIGURE 2.9 - SHUT DOWN SLIDER

Increment/Decrement Control

The + (increment) and – (decrement) buttons are used to enter numeric data, OR upon double-clicking the numerical value area, a keypad will pop up allowing direct numeric data entry:

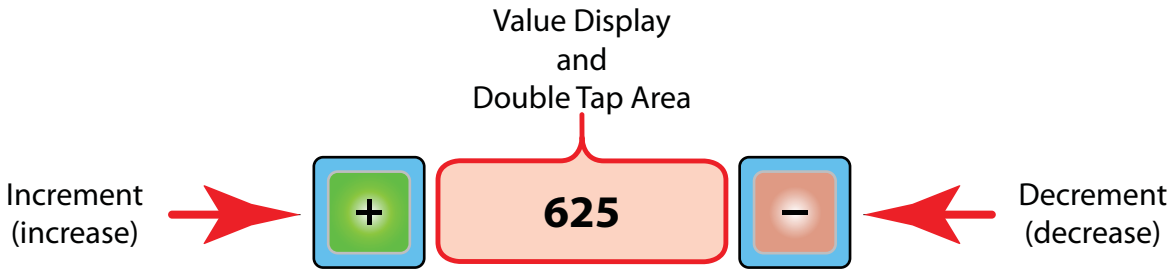


FIGURE 2.10 - INCREMENT/DECREMENT CONTROL

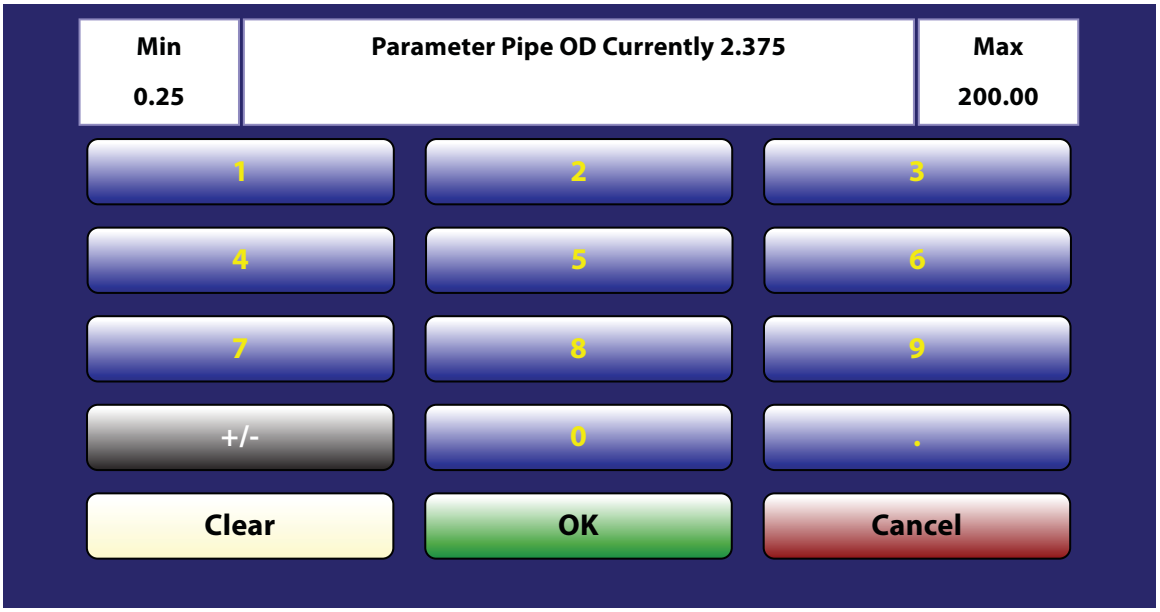


FIGURE 2.11 - NUMERIC INPUT CONTROL

Min, Max, parameters are all shown. Clear starts over and cancel closes without changes. Click "**OK**" to store. Keypad will disappear.

Combo Box

Combo boxes function as a list of alternate items that can be chosen during setup. The combo box presents as a bar with text and a downward pointing arrow directly to the left indicating the control has a selection list.

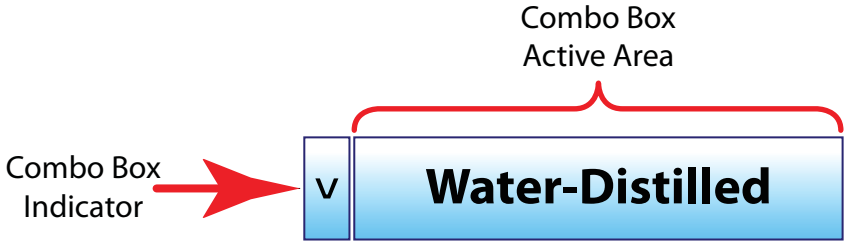


FIGURE 2.12 - RETRACTED COMBO BOX

When the combo box's active area is touched the box will expand showing the available choices for that parameter.

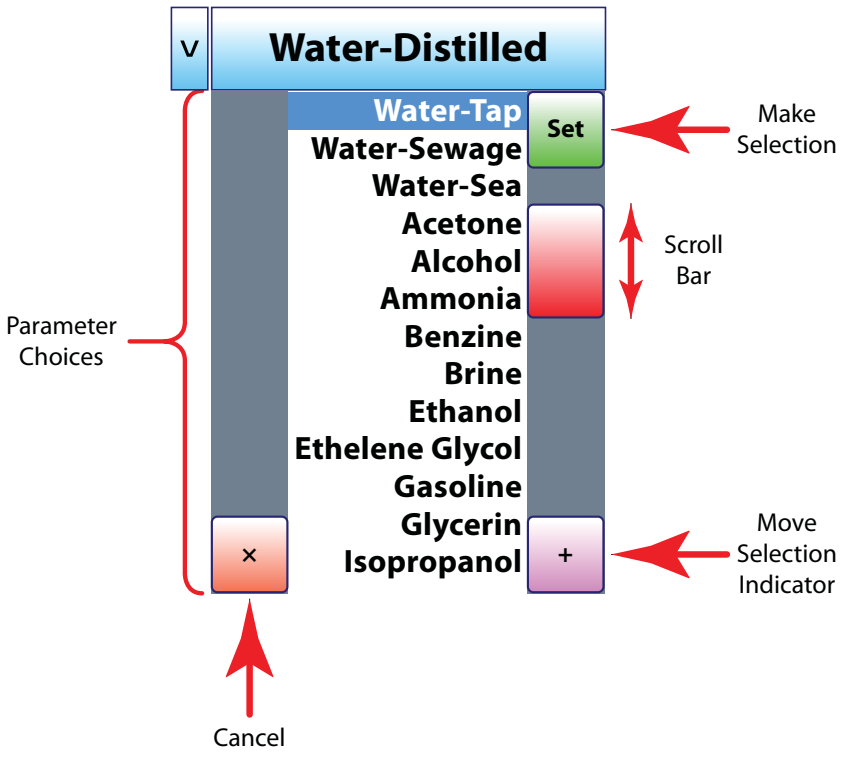


FIGURE 2.13 - COMBO BOX WITH LARGE SCROLL BAR

The + plus button moves the blue highlights area up or down depending on the original position of the highlight. Once the correct choice has been highlighted in blue use the set Set button to lock in the selection. If no change is desired use the cancel × button to exit the combo box without making any changes.

If the dropdown list of parameters is too large to be contained in one combo box length a large scroll bar will be visible allowing the list to be scrolled up or down.

A small scroll bar is also used when parameter entries are too numerous for a single screen page. The scroll bars may appear either horizontally or vertically.

FIGURE 2.14 - SMALL SCROLL BAR

3 - TRANSDUCER INSTALLATION

GENERAL GUIDELINES

At its simplest setting up the DXN portable ultrasonic measurement system consists of two steps. The first step should be configuring the electronics because the second step, mounting the transducers, requires information obtained when the electronics are configured.

Transmission Mode

The first decision to be made is what mode of ultrasonic transmission should be used. Generally the transit time mode is used with fluids that have little to no particulates or entrained air. Doppler mode is used on fluids that contain significant levels of particulates and aerated fluids. If the fluid type is unknown it is usually better to start with transit time as transit time mode is more forgiving of having some particulate or air than Doppler is of not having enough particulate or entrained air.

If the fluid type is an unknown it is also possible to mount both transit time and Doppler transducers on the same pipe and let the DXN decide which set of transducers to utilize. The DXN can operate as a dedicated transit time meter, a dedicated Doppler meter or to automatically switch between transit time and Doppler modes using the Hybrid mode.

Transducer Mounting Location

At this point it is also necessary to consider the transducer mounting location. A very loose "rule of thumb" is to mount the transducers on a section of pipe that has at least 10 pipe diameters upstream of the transducers and 5 pipe diameters downstream. See ***Table Q1*** for additional pipe length considerations.

For example if a 3 inch pipe is being measured the minimum upstream pipe in front of the transducers should be 30 inches and the minimum downstream pipe behind the transducers should be at least 15 inches.

Pipe runs shorter than the minimums may sometimes be used with reduced accuracy. Unfortunately there is no way to determine how much accuracy is sacrificed without doing in-field testing. For installations where the 10/5 pipe diameters rule can't be followed divide the total length of available straight pipe into thirds and mount the transducers with ⅔ of the pipe upstream and ⅓ of the pipe downstream.

A full pipe is absolutely essential for making accurate flow measurements in either transit time or Doppler mode. The DXN has no way to determine that the pipe is full or not. If the pipe is partially full the meter will over report the amount of flow by the percentage of the pipe that is not filled with liquid.

An optimum transducer mounting location is defined as:

- ~ A piping system that is completely full of liquid when measurements are being taken. The pipe may become empty during a process cycle – which will result in a Low Signal Strength error being displayed on the flow meter while the pipe is empty. This error code will clear automatically once the pipe refills with liquid. It is not recommended to mount the transducers in an area where the pipe may become partially filled. Partially filled pipes will cause erroneous and unpredictable operation of the meter.
- ~ A piping system that contains lengths of straight pipe such as those described in ***Table Q.1***. The optimum straight pipe diameter recommendations apply to pipes in both horizontal and vertical orientation. The straight runs in ***Table Q.1*** apply to liquid velocities that are nominally 7 FPS (2.2 MPS). As liquid velocity increases above this nominal rate, the requirement for straight pipe increases proportionally.
- ~ Mount the transducers in an area where they will not be inadvertently bumped or disturbed.
- ~ Avoid installations on downward flowing pipes unless adequate downstream head pressure is present to overcome partial filling of or cavitation in the pipe.

Pipe Preparation

After selecting an optimal mounting location and successfully determining the proper transducer spacing the transducers may now be mounted onto the pipe.

Before the transducers are mounted onto the pipe surface, an area slightly larger than the flat surface of each transducer must be cleaned of all rust, scale and moisture. For pipes with rough surfaces, such as ductile iron pipe, it is recommended that the pipe surface be wire brushed to a shiny finish. Paint and other coatings, if not flaked or bubbled, need not be removed. Plastic pipes typically do not require surface preparation other than soap and water cleaning.

Signal Quality

When the DXN is in "**Hybrid Mode**" switching between transit time and Doppler is controlled by the signal quality. For any mode setting selected from the **Meter Group ► Flow Page** the signal quality must be at least 10% to obtain any readings.

Above a signal quality of 10% but below 40% the DXN will use the mode that develops the highest signal quality. If for example the DXN sees 38% Doppler signal quality and 33% transit time signal quality Doppler mode will be automatically selected.

Above 40% signal quality the DXN will use transit time.

TRANSIT TIME TRANSDUCER INSTALLATION

In transit time mode the flow meter utilizes two transducers that function as both ultrasonic transmitters and receivers. The transducers are clamped on the outside of a closed pipe **at a specific distance from each other**. The transducers can be mounted in **V-**Mount where the sound transverses the pipe two times, **W-**Mount where the sound transverses the pipe four times, or in **Z-**Mount where the transducers are mounted on opposite sides of the pipe and the sound crosses the pipe once. The selection of mounting method is based on pipe and liquid characteristics which both have an effect on how much signal is generated. The flow meter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the time interval that it takes for sound to travel between the two transducers. The difference in the time interval measured is directly related to the velocity of the liquid in the pipe.

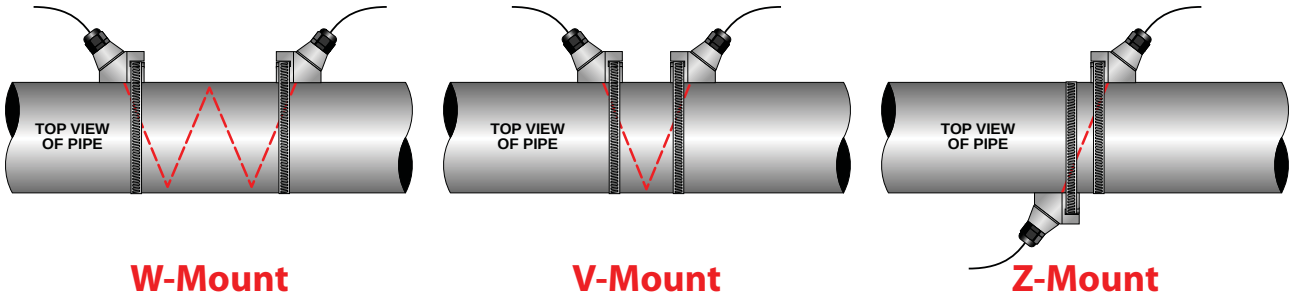


FIGURE 3.1 - TRANSIT TIME ULTRASOUND TRANSMISSION

The following information will be needed to set up the DXN for transit time operation.

1. Transducer mounting method
2. Pipe O.D. (Outside Diameter)
3. Pipe wall thickness
4. Pipe material
5. Pipe sound speed*
6. Pipe relative roughness*
7. Pipe liner thickness
8. Pipe liner material
9. Fluid type
10. Fluid sound speed*
11. Fluid viscosity*
12. Fluid specific gravity*

NOTE: *Much of the data relating to material sound speed, viscosity and specific gravity is pre-programmed into the DXN flow meter. This data only needs to be modified if it is known that a particular application's data varies from the reference values. Refer to* ***Part 4*** *of this manual for instructions on entering configuration data into the DXN flow meter .*

**NOMINAL VALUES FOR THESE PARAMETERS ARE INCLUDED WITHIN THE DXN OPERATING SYSTEM. THE NOMINAL VALUES MAY BE USED AS THEY APPEAR OR MAY BE MODIFIED IF EXACT SYSTEM VALUES ARE KNOWN.*

DTTN, DTTH, and DTTL Transducers

The appropriate mounting configuration is based on pipe and liquid characteristics. Selection of the proper transducer mounting method is not entirely predictable and many times is an iterative process. ***Table 3.1*** contains recommended mounting configurations for common applications. These recommended configurations may need to be modified for specific applications if such things as aeration, suspended solids, out of round piping or poor piping conditions are present. Use of the DXN diagnostics in determining the optimum transducer mounting is covered later in this section.

TRANSDUCER MOUNT MODE	TRANSDUCER	PIPE MATERIAL	PIPE SIZE
W-Mount	DTTN/DTTH	Plastic (all types)	2-4 in. (50-100 mm)
		Carbon Steel	
		Stainless Steel	
		Copper	
		Ductile Iron	Not recommended
		Cast Iron	
	DTTL	Plastic (all types)	8-16 in. (203-406 mm)
		Carbon Steel	
		Stainless Steel	
		Copper	
		Ductile Iron	Not recommended
		Cast Iron	
V-Mount	DTTN/DTTH	Plastic (all types)	4-12 in. (203-406 mm)
		Carbon Steel	
		Stainless Steel	
		Copper	4-30 in. (100-750 mm)
		Ductile Iron	2-12 in. (50-300 mm)
		Cast Iron	
	DTTL	Plastic (all types)	16-48 in (406-1220 mm)
		Carbon Steel	16-36 in (406-915 mm)
		Stainless Steel	
		Copper	16-48 in (406-1220 mm)
		Ductile Iron	16-30 in (406-750 mm)
		Cast Iron	
Z-Mount	DTTN/DTTH	Plastic (all types)	> 30 in. (> 750 mm)
		Carbon Steel	> 12 in. (> 300 mm)
		Stainless Steel	
		Copper	> 30 in. (> 750 mm)
		Ductile Iron	> 12 in. (> 300 mm)
		Cast Iron	
	DTTL	Plastic (all types)	> 48 in. (> 1220 mm)
		Carbon Steel	> 36 in. (> 915 mm)
		Stainless Steel	
		Copper	> 48 in. (> 1220 mm)
		Ductile Iron	> 30 in. (> 750 mm)
		Cast Iron	
TSS = Total Suspended Solids			

TABLE 3.1 - STARTING POINT TRANSDUCER MOUNTING MODES — DTTN, DTTL, AND DTTH

For pipes 24" (600 mm) and larger the DTTL transducers using a transmission frequency of 500 KHz are recommended.

DTTL transducers may also be advantageous on pipes between 4" and 24" if there are less quantifiable complicating aspects such as – sludge, tuberculation, scale, rubber liners, plastic liners, thick mortar, gas bubbles, suspended solids, emulsions, or pipes that are perhaps partially buried where a **V**-mount is required/desired, etc.

The DTTN, DTTH and DTTL transducers must be properly oriented and spaced on the pipe to provide optimum reliability and performance. On horizontal pipes, when **Z**-Mount is required, the transducers should be mounted 180 radial degrees from one another and at least 45 degrees from the top-dead-center and bottom-dead-center of the pipe. See ***Figure 3.2***. Also see **Z**-Mount Transducer Installation. On vertical pipes the orientation is not critical.

The best accuracy is achieved when transducer spacing is exactly what the DXN calculates, so the calculated spacing should be used if signal quality is satisfactory. If the pipe is not round, the wall thickness not correct or the actual liquid being measured has a different sound speed than the liquid programmed into the transmitter, the spacing can vary from the calculated value. If that is the case, the transducers should be placed at the highest signal level observed by moving the transducers slowly around the mount area.

NOTE: *Transducer spacing is calculated on "ideal" pipe. Ideal pipe is almost never found so the transducer spacing distances may need to be altered. An effective way to maximize signal quality is to configure the display to show signal quality, fix one transducer on the pipe and then starting at the calculated spacing, move the remaining transducer small distances forward and back to find the maximum signal quality point.*

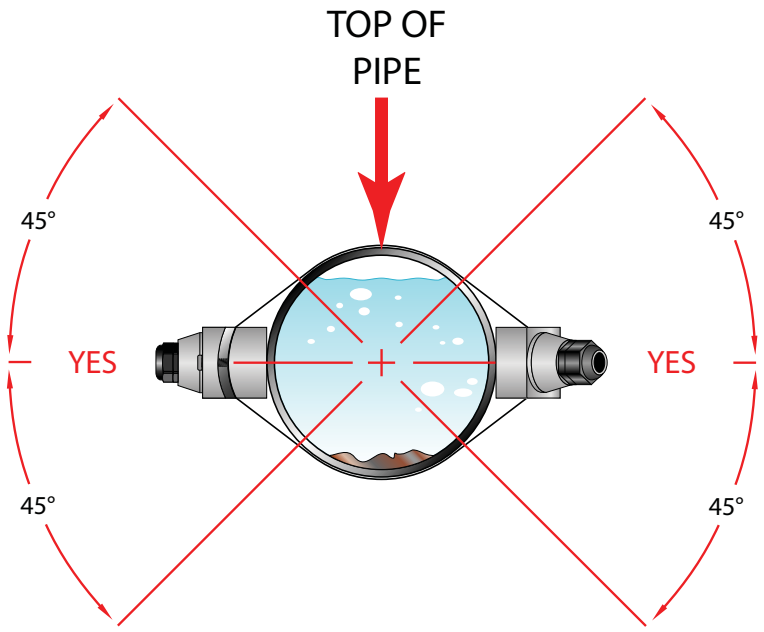


FIGURE 3.2 - TRANSDUCER ORIENTATION - HORIZONTAL PIPES

The spacing between the transducers is measured between the two spacing marks on the sides of the transducers. These marks are approximately 0.75" (19 mm) back from the nose of the DTTN and DTTH transducers, and 1.2" (30 mm) back from the nose of the DTTL transducers. See ***Figure 3.3***.

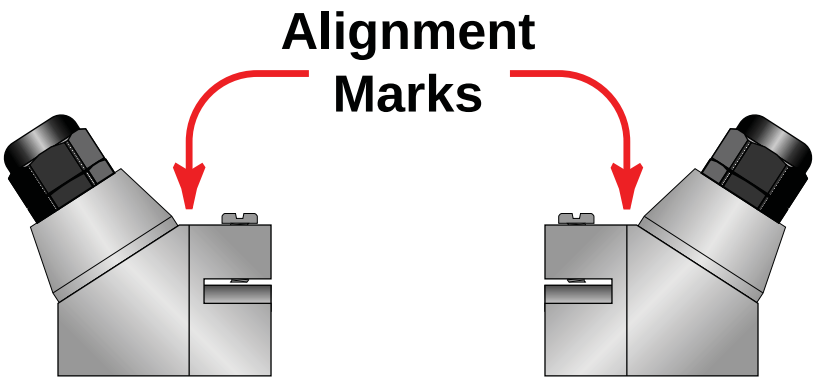


FIGURE 3.3 - TRANSDUCER ALIGNMENT MARKS

V-MOUNT AND W-MOUNT INSTALLATION

Application of Couplant

For DTTN, DTTH and DTTL transducers, place a single bead of couplant, approximately ½ inch (12 mm) wide, on the flat face of the transducer. See ***Figure 3.4***. Generally, a silicone-based grease is used as an acoustic couplant, but any grease-like substance that is rated not to "flow" at the temperature that the pipe may operate at will be acceptable.

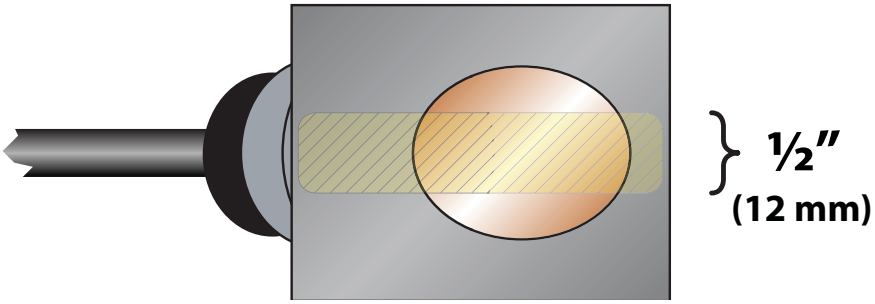


FIGURE 3.4 - APPLICATION OF COUPLANT

Transducer Positioning

1) Place the upstream transducer in position and secure with a mounting strap. Straps should be placed in the arched groove on the end of the transducer. A screw is provided to help hold the transducer onto the strap. Verify that the transducer is true to the pipe and adjust as necessary. Tighten the transducer strap securely.
2) Place the downstream transducer on the pipe at the calculated transducer spacing. See ***Figure 3.5***. Apply firm hand pressure. If signal quality is greater than 10, secure the transducer at this location. If the signal quality is not 10 or greater, using firm hand pressure slowly move the transducer both towards and away from the upstream transducer while observing signal quality.

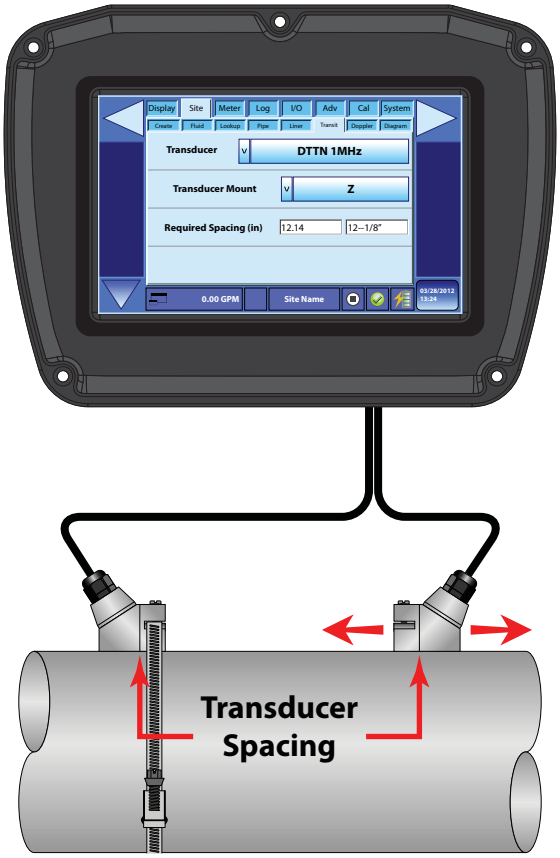


FIGURE 3.5 - TRANSDUCER POSITIONING

NOTE: *Signal quality readings update only every few seconds, so it is advisable to move the transducer ⅛", wait, see if signal is increasing or decreasing and then repeat until the highest level is achieved.*

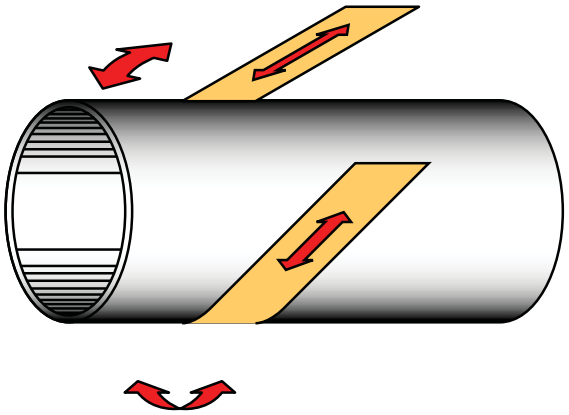
Signal quality can be viewed on the DXN's display. Clamp the transducer at the position where the highest signal quality is observed. The factory default signal quality setting is 10, however there are many application specific conditions that may prevent the signal quality from attaining this level. For the DXN, signal levels less than 10 will not give readings.

3) If after adjustment of the transducers the signal quality does not rise to above 10, then an alternate transducer mounting method should be selected. If the mounting method was **W**-Mount, then re-configure the transmitter for **V**-Mount, move the downstream transducer to the new spacing distance.

NOTE: *As a rule, the DTTL should be used on pipes 24" and larger and not used for application on a pipe smaller than 4". Consider application of the DTTL transducers on pipes smaller than 24" if there are less quantifiable aspects such as - sludge, tuberculation, scale, rubber liners, plastic liners, thick mortar liners, gas bubbles, suspended solids, emulsions, and smaller pipes that are perhaps partially buried where a **V**-Mount is required/desired, etc.*

MOUNTING TRANSDUCERS IN Z-MOUNT CONFIGURATION

Installation on larger pipes requires careful measurements of the linear and radial placement of the DTTN, DTTH or DTTL transducers. Failure to properly orient and place the transducers on the pipe may lead to weak signal quality and/or inaccurate readings. This section details a method for properly locating the transducers on larger pipes. This method requires a roll of paper such as freezer paper or wrapping paper, masking tape and a marking device.



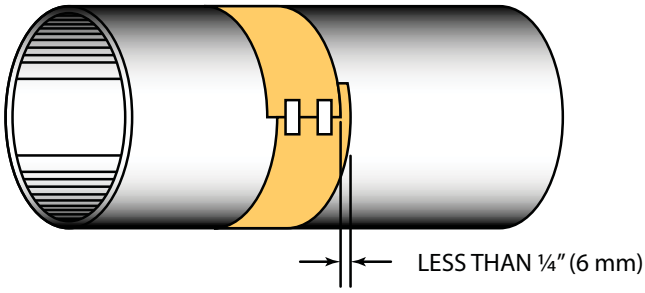


FIGURE 3.6 - PAPER TEMPLATE ALIGNMENT

1) Wrap the paper around the pipe in the manner shown in ***Figure 3.6***. Align the paper ends to within ¼ inch (6 mm).
2) Mark the intersection of the two ends of the paper to indicate the circumference. Remove the template and spread it out on a flat surface. Fold the template in half, bisecting the circumference. See ***Figure 3.7***.
3) Crease the paper at the fold line. Mark the crease. Place a mark on the pipe where one of the transducers will be located. See ***Figure 3.2*** for acceptable radial orientations. Wrap the template back around the pipe, placing the beginning of the paper and one corner in the location of the mark. Move to the other side of the pipe and mark the pipe at the ends of the crease. Measure from the end of the crease (directly across the pipe from the first transducer location) the length from the **Required Spacing** entry in the **Site Group ► Transit Page** screen. Mark this location on the pipe.
4) The two marks on the pipe are now properly aligned and measured.

If access to the bottom of the pipe prohibits the wrapping of the paper around the circumference, cut a piece of paper ½ the circumference of the pipe and lay it over the top of the pipe. The length of ½ the circumference can be found by:

½ Circumference = Pipe O.D. × 1.57

The transducer spacing is the same as found in the Transducer Positioning section.

Mark opposite corners of the paper on the pipe. Apply transducers to these two marks.

5) For DTTN, DTTH and DTTL transducers, place a single bead of couplant, approximately ½ inch (12 mm) thick, on the flat face of the transducer. See ***Figure 3.4***. Generally, a silicone-based grease is used as an acoustic couplant, but any good quality grease-like substance that is rated to not "flow" at the temperature that the pipe may operate at will be acceptable.

6) Place the upstream transducer in position and secure with a stainless steel strap or other fastening device. Straps should be placed in the arched groove on the end of the transducer. A screw is provided to help hold the transducer onto the strap. Verify that the transducer is true to the pipe, adjust as necessary. Tighten transducer strap securely. Larger pipes may require more than one strap to reach the circumference of the pipe.

7) Place the downstream transducer on the pipe at the calculated transducer spacing. See ***Figure 3.8***. Using firm hand pressure, slowly move the transducer both towards and away from the upstream transducer while observing signal quality. Clamp the transducer at the position where the highest signal quality is observed. Signal quality of between 5 and 98 is acceptable. The factory default signal quality setting is 10, however there are many application specific conditions that may prevent the signal quality from attaining this level.

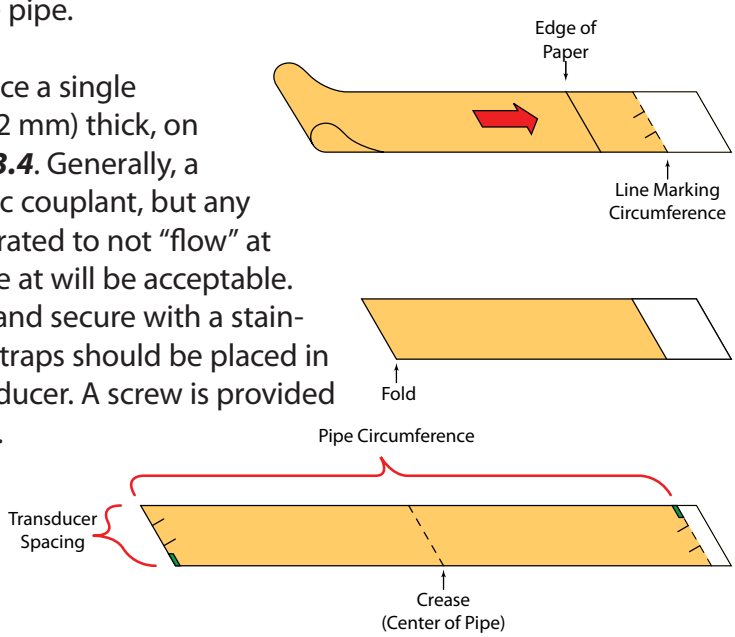


FIGURE 3.7 - BISECTING THE PIPE CIRCUMFERENCE

A minimum signal quality of 10 is acceptable as long as this signal level is maintained under all flow conditions.

On certain pipes, a slight twist to the transducer may cause signal quality to rise to acceptable levels.

8) Certain pipe and liquid characteristics may cause signal quality to rise to greater than 98. The problem with operating a DXN with very high signal quality is that the signals may saturate the input amplifiers and cause erratic readings. Strategies for lowering signal quality would be changing the transducer mounting method to the next longest transmission path. For example, if there is excessive signal quality levels and the transducers are mounted in a **Z**-Mount, try changing to **V**-Mount or **W**-Mount. Finally you can also move one transducer slightly off line with the other transducer to lower signal quality.

9) Secure the transducer with a stainless steel strap or other fastener.

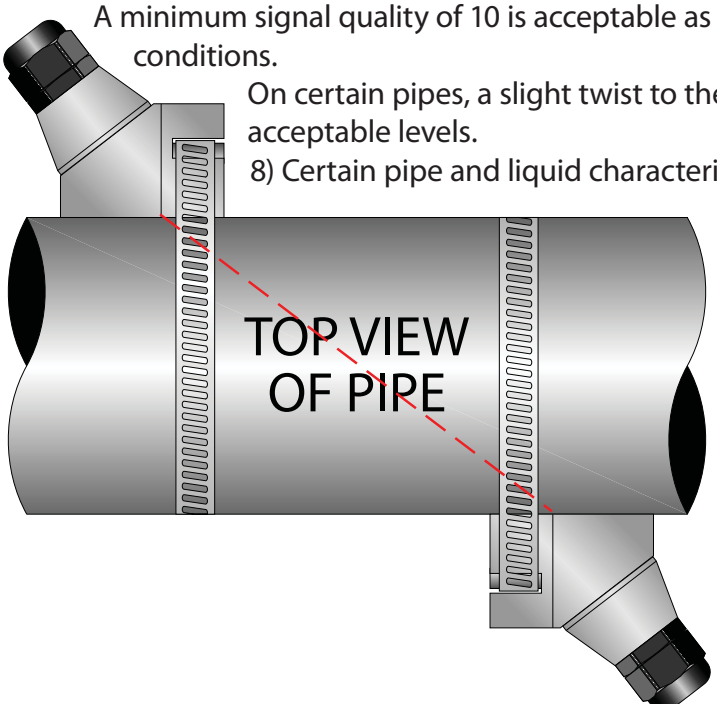


FIGURE 3.8 - Z-MOUNT TRANSDUCER PLACEMENT

MOUNTING TRACK INSTALLATION

1) A convenient transducer mounting track can be used for pipes that have outside diameters between 2 and 10 inches (50 and 250 mm). If the pipe is outside of that range, select a **V**-Mount or **Z**-Mount mounting method.
2) Install the single mounting rail on the side of the pipe with the stainless steel bands provided. Do not mount it on the top or bottom of the pipe. Orientation on vertical pipe is not critical. Ensure that the track is parallel to the pipe and that all four mounting feet are touching the pipe.
3) Slide the two transducer clamp brackets towards the center mark on the mounting rail.
4) Place a single bead of couplant, approximately ½ inch (12 mm) thick, on the flat face of the transducer. See ***Figure 3.4***.
5) Place the first transducer in between the mounting rails near the zero point on the scale. Slide the clamp over the transducer. Adjust the clamp/transducer such that the notch in the clamp aligns with zero on the scale. See ***Figure 5.9***.
6) Secure with the thumb screw. Ensure that the screw rests in the counter bore on the top of the transducer. (Excessive pressure is not required. Apply just enough pressure so that the couplant fills the gap between the pipe and transducer.)
7) Place the second transducer in between the mounting rails near the dimension derived in the transducer spacing section. Read the dimension on the mounting rail scale. Slide the transducer clamp over the transducer and secure with the thumb screw.

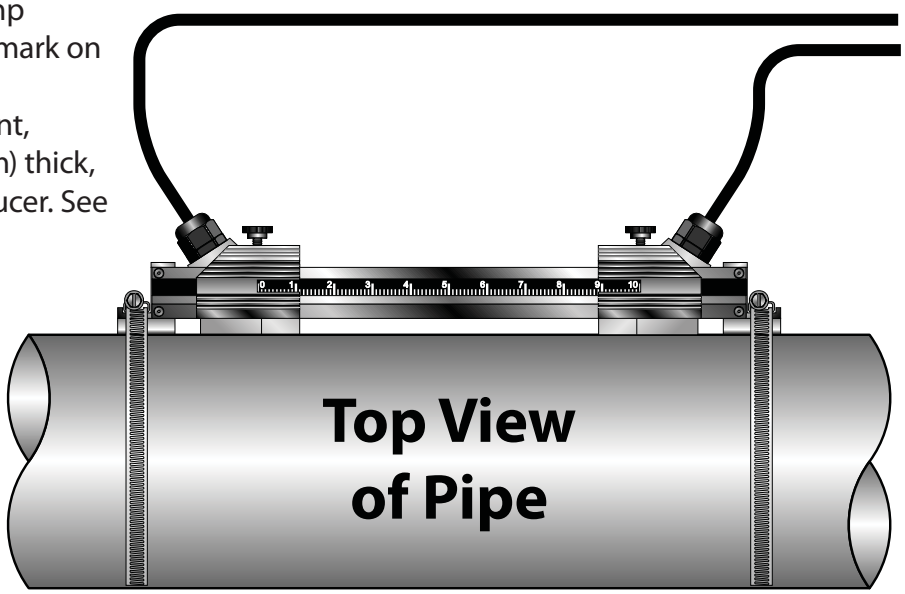


FIGURE 3.9 - MOUNTING TRACK INSTALLATION

DTTSU SMALL PIPE TRANSDUCER INSTALLATION

DTTSU transducers should be mounted with the cable exiting within ±45 degrees of the side of a horizontal pipe. See ***Figure 3.10***. On vertical pipes the orientation does not apply.

TheDTTSU small pipe transducers are adjustable for pipe sizes between ½" (12 mm) and 2" (50 mm). Do not attempt to mount a DTTSU transducer onto a pipe that is either too large or too small for the transducer.

NOTE: *All DTTSU transducers use a 2 MHz transmission frequency and* ***V****-Mount configuration.*

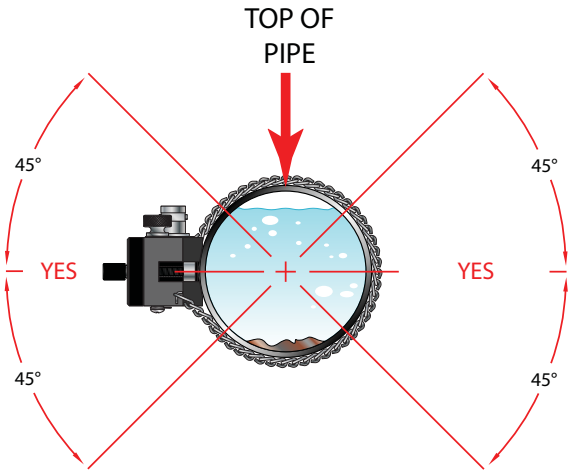


FIGURE 3.10 - DTTSU POSITIONING

DTTSU installation consists of the following steps:

1) Determine the transducer spacing required using the DXN and using the scale on the side of the DTTSU transducers, set the spacing. See ***Figure 3.11.***
2) On horizontal pipes, mount the transducer in an orientation such that the cable exits at ±45 degrees from the side of the pipe. Do not mount with the cable exiting on either the top or bottom of the pipe. On vertical pipes the orientation does not matter.

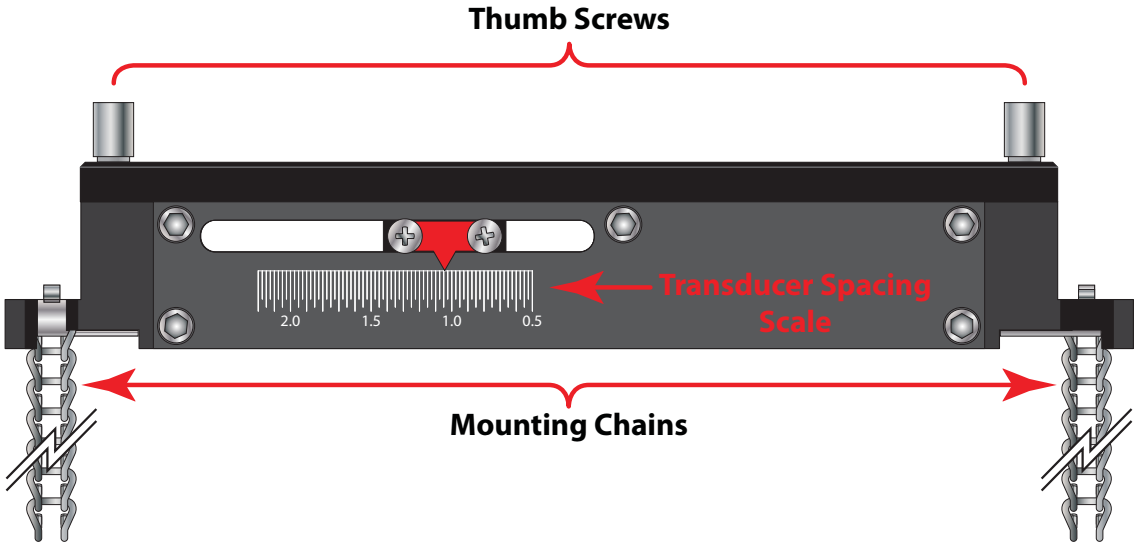


FIGURE 3.11 - TRANSDUCER SPACING SCALE - DTTSU TRANSDUCERS

3) Wrap the mounting chains around the pipe and secure the chains to their respective mounting cleats. See **Figure 3.13**

NOTE: *The chains do not need to be taught at this point. Any slack in the chains will be removed when the thumb screws are adjusted.*

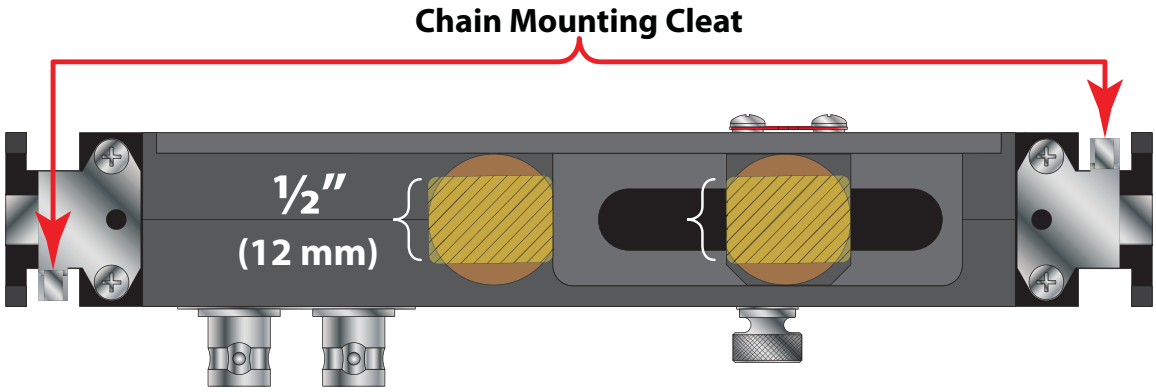


FIGURE 5.12 - APPLICATION OF ACOUSTIC COUPLANT - DTTSU TRANSDUCERS

4) Finger tighten the thumb screws so that the acoustic coupling grease begins to flow out from the under the transducer **Do not over tighten**.
5) If signal quality is less than 10, remount the transducer at another location on the piping system.

DOPPLER TRANSDUCER INSTALLATION

For Doppler installation the only pipe information needed is the Pipe ID (Inside Diameter)

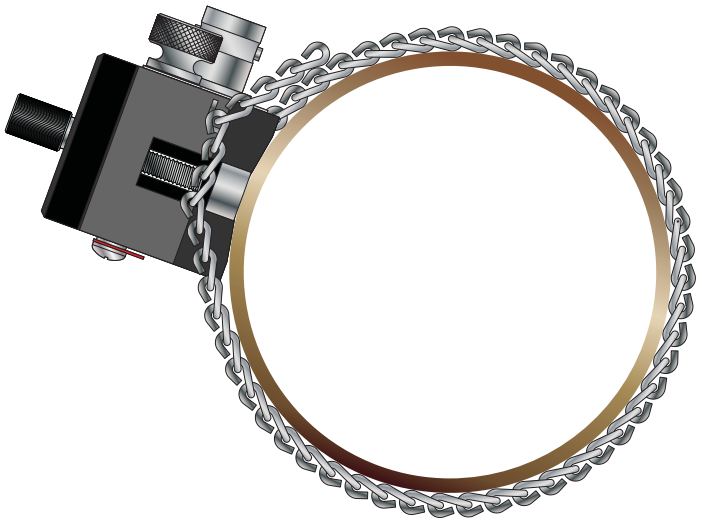


FIGURE 3.13 - DTTSU TRANSDUCERS - MOUNTED

Sonic Reflectors for Doppler Mode

Flow meters based on Doppler shift principals operate by transmitting an ultrasonic sound from its transmitting transducer through the pipe wall into the flowing liquid. The sound will be reflected by useful sonic reflectors suspended within the liquid and recorded by the receiving transducer. If the sonic reflectors are moving within the sound transmission path, sound waves will be reflected at a frequency shifted (Doppler frequency) from the transmitted frequency. The shift in frequency will be directly related to the speed of the moving particle or bubble. This shift in frequency is interpreted by the instrument and converted to various user defined measuring units.

The four criteria for a good Doppler reflectors are:

- ~ The scattering material must have a sonic impedance (sound speed difference) different from the fluid. The minimum difference must be at least 10%.
- ~ There must be some particles large enough to cause longitudinal reflection - particles larger than 35 micron (435 mesh).
- ~ For a given pipe size, the longitudinal reflection must have sufficient energy to overcome the Rayleigh (energy wasting) scattering caused by smaller particles.
- ~ The reflecting material must travel at the same velocity as the fluid for good accuracy.

Doppler Installation

Doppler transducers should be mounted on the pipe 180° apart and facing each other on the pipe, with the cables on the downstream side of the transducers. If the pipe is horizontal, the preferred mounting orientation is 3 and 9 o'clock, with 12 o'clock being the top of the pipe. See ***Figure 3.14***. Orientation on vertical pipes does not matter.

NOTE: *Doppler transducers may be mounted on the same pipe as transit time transducers without encountering acoustic cross-talk.*

PROCEDURE:

1) Large pipe installations utilize stainless steel straps to secure the transducers to the outside of the pipe. The DXN system is shipped with four 36" (900 mm) straps, which are suitable for pipes up to 39" (1000 mm) diameter. Select the proper number of transducer straps to allow a complete strap to go around the circumference of the pipe.

2) Wrap the strap around the pipe in the area where the transducers are to be mounted. Leave the strap loose enough to allow the transducers to be placed underneath. If multiple straps are being used, it can be beneficial to wrap electrical tape around all but one strap connection to secure the strap worm screws in place.
3) Spread an even layer of coupling compound, approximately ⅛" (3 mm) thick by ½" (12 mm) wide, to the bottom flat face of the two transducers.
4) Place each transducer under the strap with the flat face – amber plastic window – positioned towards the pipe. The notch on the back of the transducer will provide a mounting surface for the strap. The transducer cables must be facing in the same direction and in the downstream direction for proper operation.

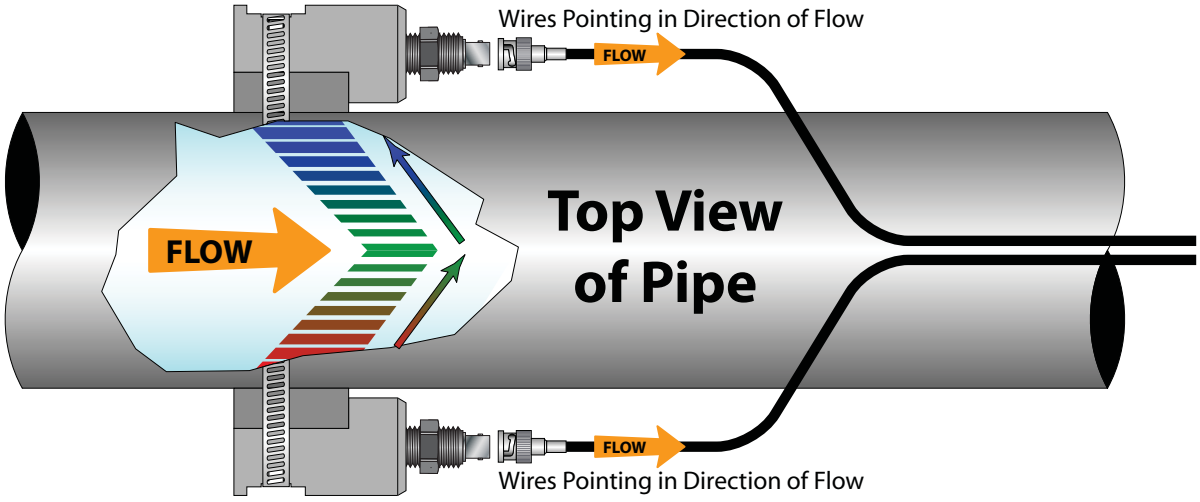


FIGURE 3.14 - DOPPLER TRANSDUCER PLACEMENT

NOTE: *Large pipes may require two people for this procedure.*

5) Tighten the strap strong enough to hold the transducers in place, but not so tight that all of the couplant squeezes out of the gap between the transducer face and pipe. Ensure that the transducers are squarely aligned on the pipe and 180° apart.
6) Route the transducer cables back to the area where the transmitter will be, avoiding high voltage cable trays and conduits.

NOTE: *Where a high amount of particulates are expected mounting the transducers "side-by-side" may allow enough sound reflection for the Doppler function to work. See* ***Figure 3.15***

NOTE: *Low particulate content may sometimes be overcome by mounting the Doppler transducers downstream of a pipe elbow. A better solution to a low particulate fluid would be switching over to transit time measurements.*

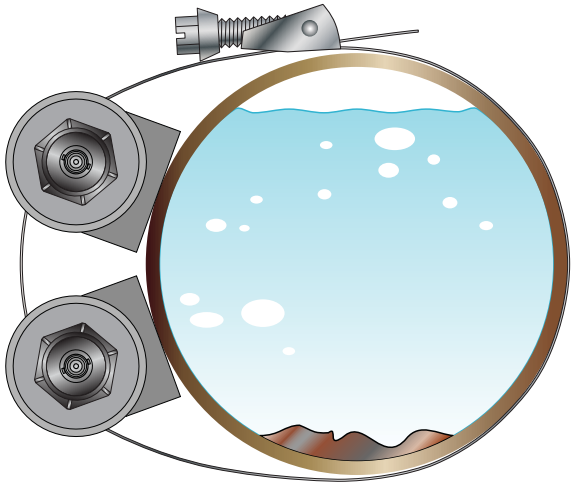


FIGURE 3.15 - SIDE-BY-SIDE PLACEMENT

Mounting Straps

The most economical way to affix transducers to a pipe is by the use of adjustable mounting straps. Individual straps in both 36" (915 mm) and 72" (1830 mm) are available from Dynasonics. See **Figure 5.12**. The straps can be connected together to make a continuous length. Small pipe transducer installations do not utilize straps, but use an integral clamping mechanism built into the transducer.

Pipe Size	36" Straps Required*
1" to 9" (25 mm to 225 mm)	1
10" to 19" (250 mm to 480 mm)	2
20" to 29" (500 mm to 740 mm)	3
30" to 39" (760 mm to 1000 mm)	4
* The above table indicates the number of straps required to mount one transducer. For transit time installations two transducers must be mounted. Doppler transducers are mounted either opposite each other or side-by-side and considered a single transducer for calculating the number of straps required.	

TABLE 3.2 - STRAPS REQUIRED VS. PIPE SIZE

4 - DISPLAY OPERATION AND CONFIGURATION

CAUTION **Caution:** The DXN is designed to operate for extended periods with free air movement to cool the meter. The unit **should not** be operated for more than 30 minutes in a closed case including the canvas carrying case.

Important Note: The screen should be cleaned only with the cleaning kit supplied. Common cleaning chemicals such as "glass cleaner" shouldn't be used. The exterior surfaces of the meter can be cleaned using a clean, soft cloth and water.

Menu Conventions

The DXN uses a sophisticated touch screen user interface to control all functions. The tabbed menu tree provides access to all controls and settings using a **Group ► Page** layout for navigation.

When navigating the DXN menus this manual will specify first the group tab name and then the page (**Group ► Page**) as shown in the example below.

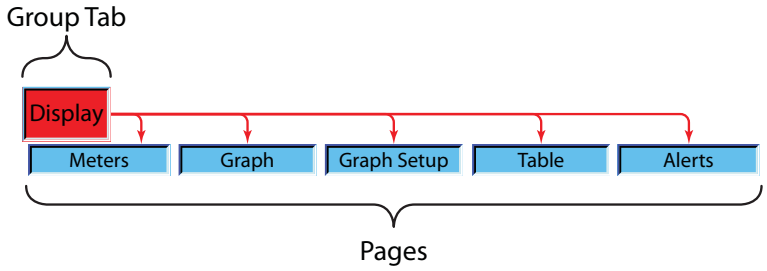


FIGURE 4.1 - GROUP ► PAGE FORMAT

MAIN SCREEN

The DXN main screen contains all the controls needed to manipulate the user interface. The meter uses buttons, drop-downs and scroll bars to configure meter functions.

FIGURE 4.2 - MAIN DISPLAY SCREEN

Status Bars

The status bar arrow key, in the bottom left hand corner, controls which of the available status bars are displayed . Single presses to the status bar arrow key will scroll through the various functions the status bar controls or displays.

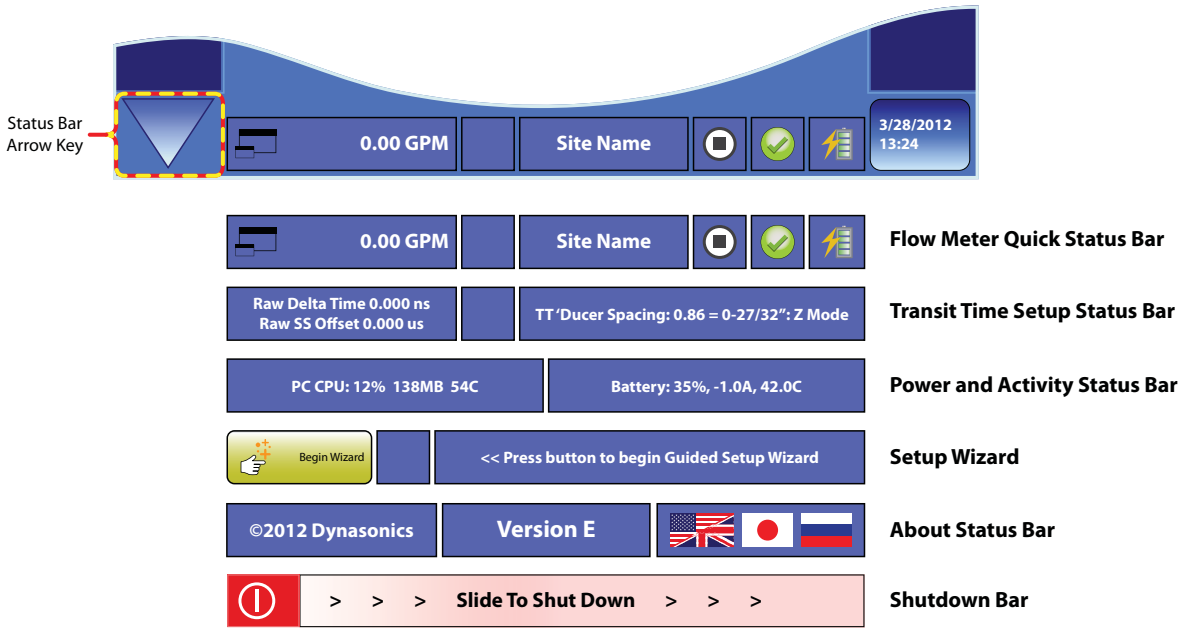


FIGURE 4.3 - STATUS BARS

The Flow Meter Quick Status Bar also has a segment that does double duty as a button

.

Full Screen On/Off

FIGURE 4.4 -STATUS BAR BUTTON

The left most segment of the Flow Meter Quick Status Bar turns on/off Full Screen mode when pressed. The Quick Status Bar also has a number of "Shortcuts" leading to some of the most referenced menu screens.

The Battery icon brings up the **System Group ► Power Page** screen showing real time battery condition.

The Communications icon brings up the **System Group ► Comm Page** screen showing continuous data being output to the active serial port.

The Datalogger shortcut reveals the **Log Group ► Setup Page** control screen allowing quick access to the datalogger controls.

The Shut Down slider bar provides a quick way of turning the meter off. Simply touch the dark left side of the bar and drag it to the right to turn the meter off.

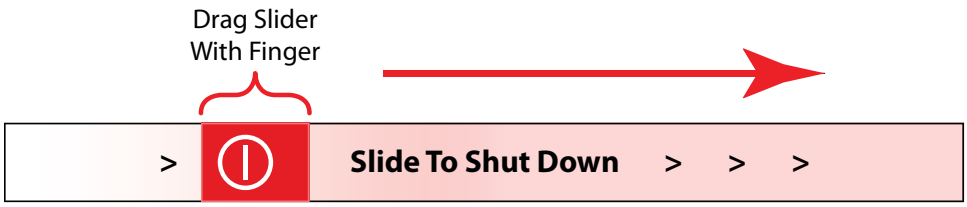


FIGURE 4.5 - SHUT DOWN SLIDER

DISPLAY GROUP

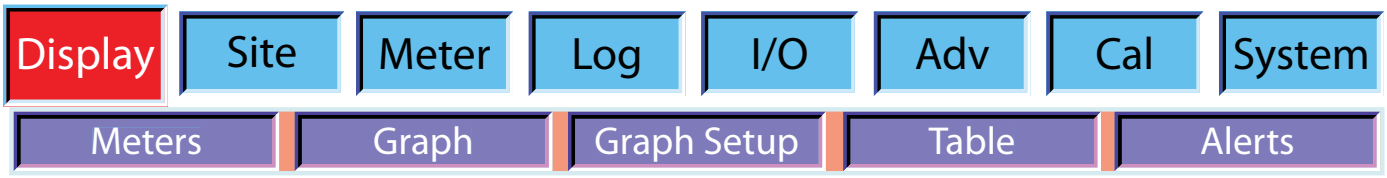


FIGURE 4.6 -DISPLAY PAGE GROUP

Meters Page

The "**Home**" display is to show meters that can indicated almost any of the system data.

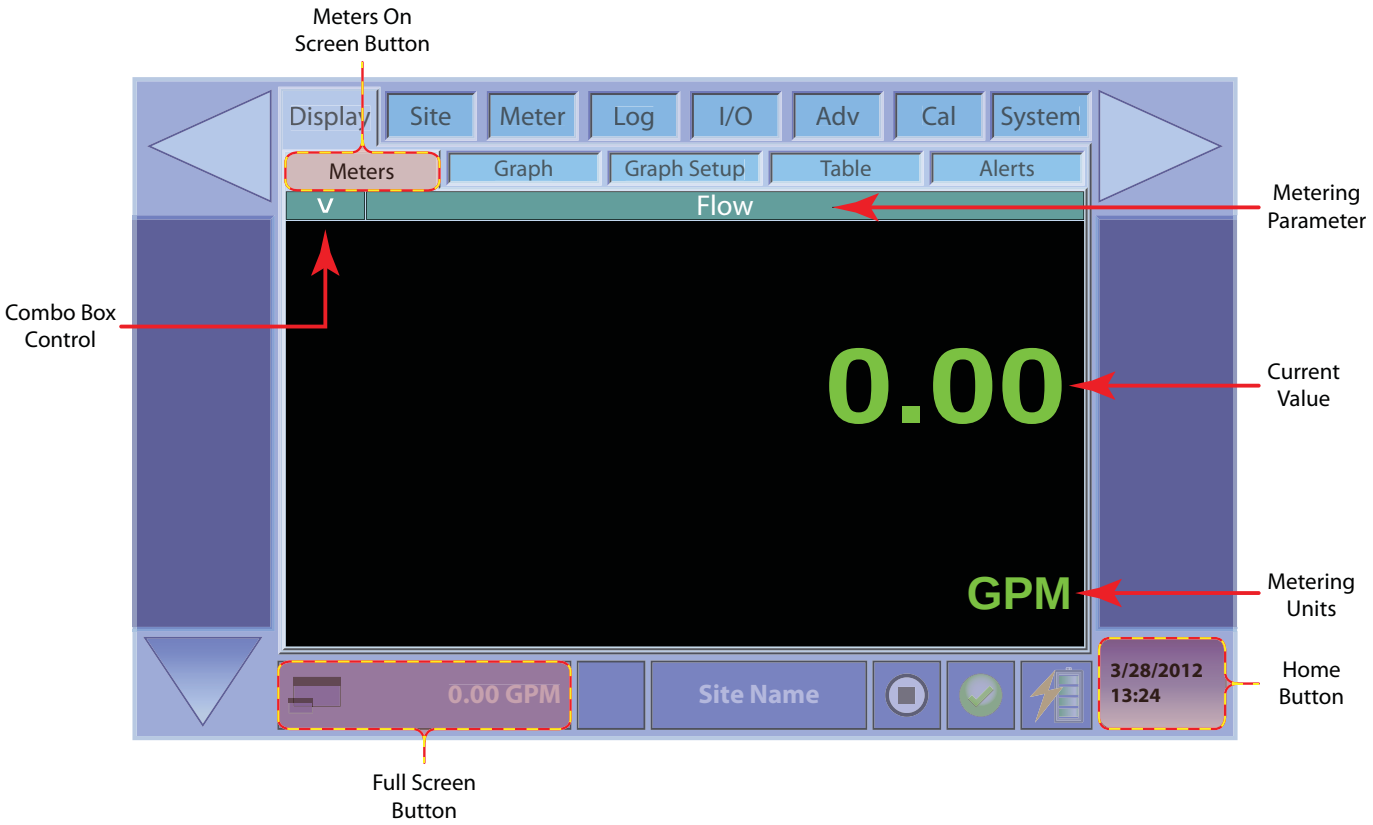


FIGURE 4.7 - METERS PAGE

The DXN can show up to 4 different parameters sub screens on the main screen. The number of individual sub screens shown is controlled by the **Display Group ► Meters Page** button.

To change the number of sub screens shown:

1) Double click **Meters** tab to change number of meter sub screens shown.
2) Single click **Full Screen** button on the Flow Meter Quick Status Bar to turn the full screen function on or off (See ***Figure 4.4***).

NOTE: *Currently 1, 3, or 4 meters can be on the screen at a time.*

The metering parameters displayed can be changed by clicking on the combo box in the upper left corner of each screen or sub screen. When the down arrow key is pressed a drop down menu becomes available allowing the choice of parameter to be displayed on that screen or sub screen. ***Figure 4.8*** shows an example of the drop down menu.

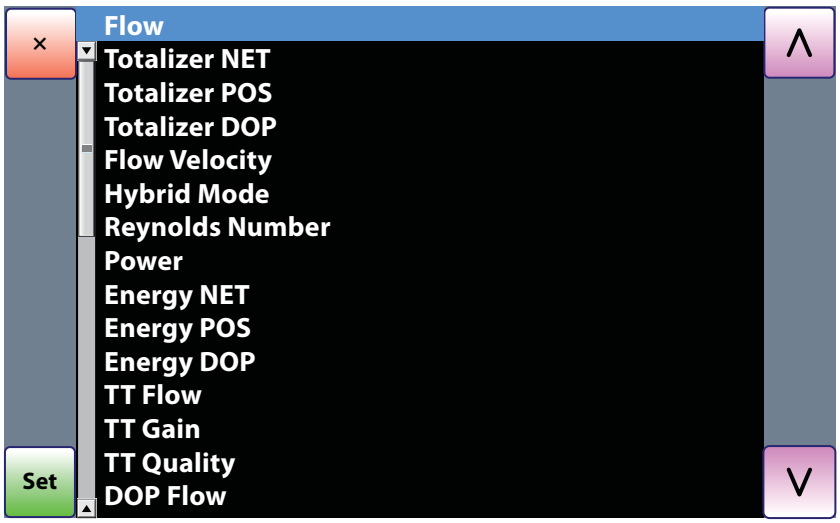


FIGURE 4.8 - PARAMETER CHOICES

Table 4.1 shows all of the available metering parameter choices.

Flow	Energy POS	TT Delta T	RTD2 Temperature
Totalizer NET	Energy DOP	TT Delta T Raw	RTD Delta Temp
Totalizer POS	TT Flow	TT TOF Bias Raw	IO Voltage In
Totalizer DOP	TT Gain	TT TOF Fluid	IO Digital In
Flow Velocity	TT Quality	TT Fluid SOS	IO Voltage Out
Hybrid Mode	DOP Flow	DOP Flow Velocity	IO Current Out
Reynolds Number	DOP Gain	DOP Frequency	IO Digital Out
Power	DOP Quality	TT Aperture Start	
Energy NET	TT Flow Velocity	RTD1 Temperature	
TT = Transit Time DOP = Doppler			

TABLE 4.1 - METERS PAGE PARAMETER CHOICES

Graph Page

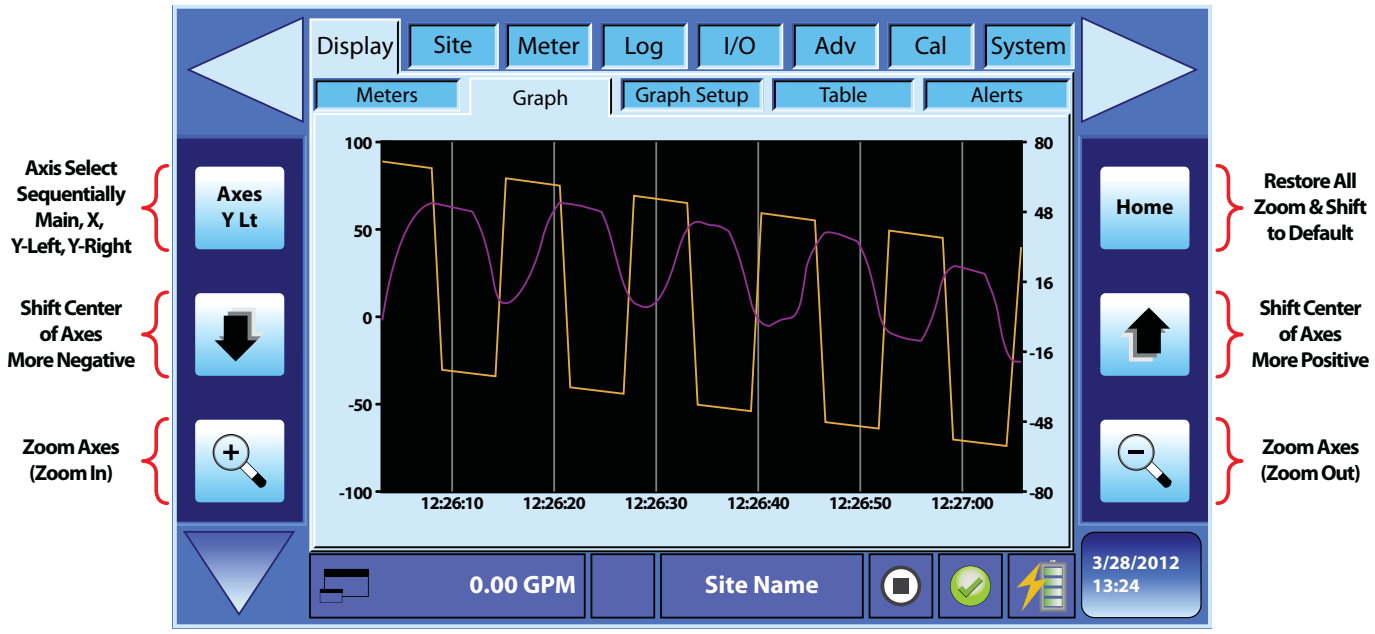


FIGURE 4.9 - GRAPH PAGE

Axes Scaling Buttons

Control of the axis scaling is performed with the axes scaling buttons. Pressing the **Axes** button successively will move through the three axis configuration choices as shown in ***Figure 4.10***.

The X axis is always time based. Use the or buttons to either expand or contract the time line shown on the horizontal (X axis). The minimum graph time period is 10 seconds and the maximum is 1 year.

The and functions control the scale of the left hand and right hand sides of the graph respectively.

The and buttons work in the same fashion as on the X axis except for on the Y Lt and Y Rt axis they are used to expand or contract the range of the vertical scaling.

The and arrow buttons are used to shift the zero point of the graph up or down.

Pressing the button resets the graph to the parameters set using the **Graph Group ► Setup Page** screen.

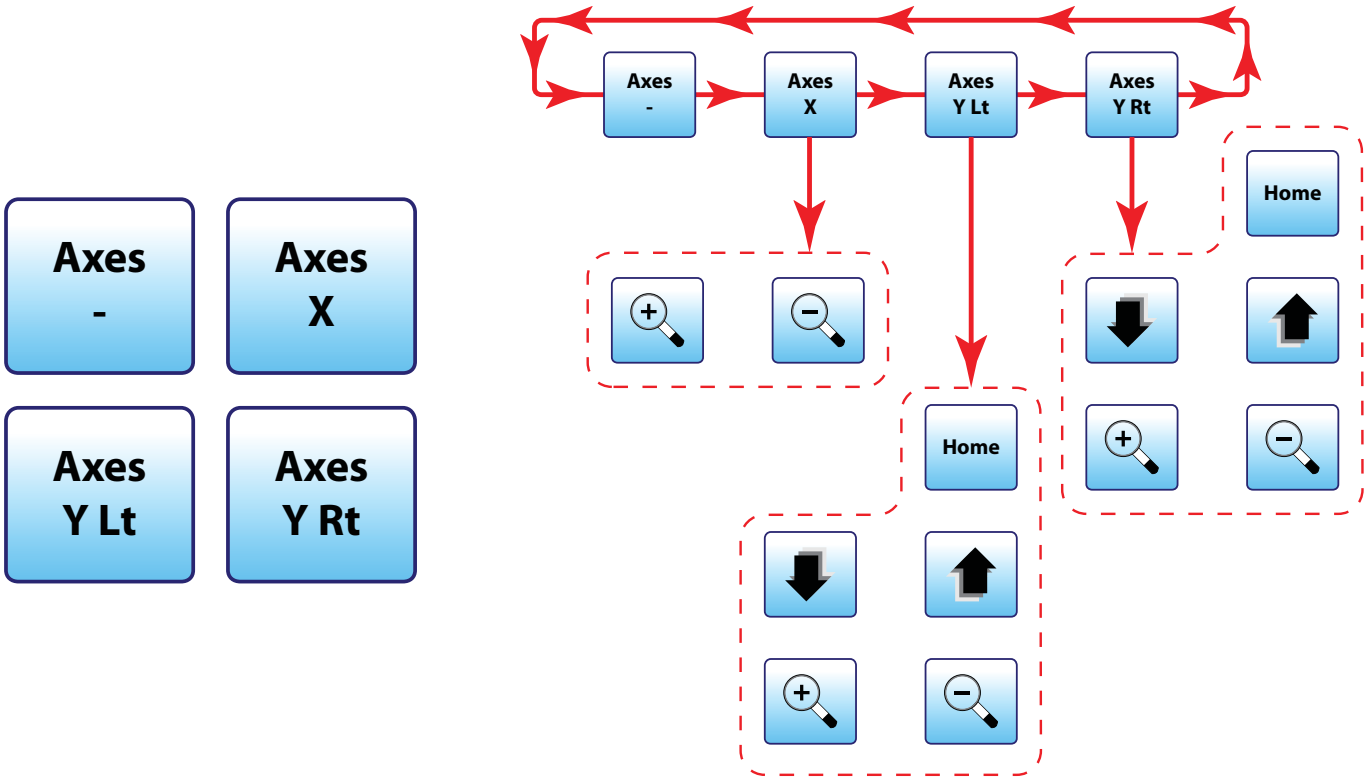


FIGURE 4.10 - GRAPH AXIS CONFIGURATION

Graph Setup Page

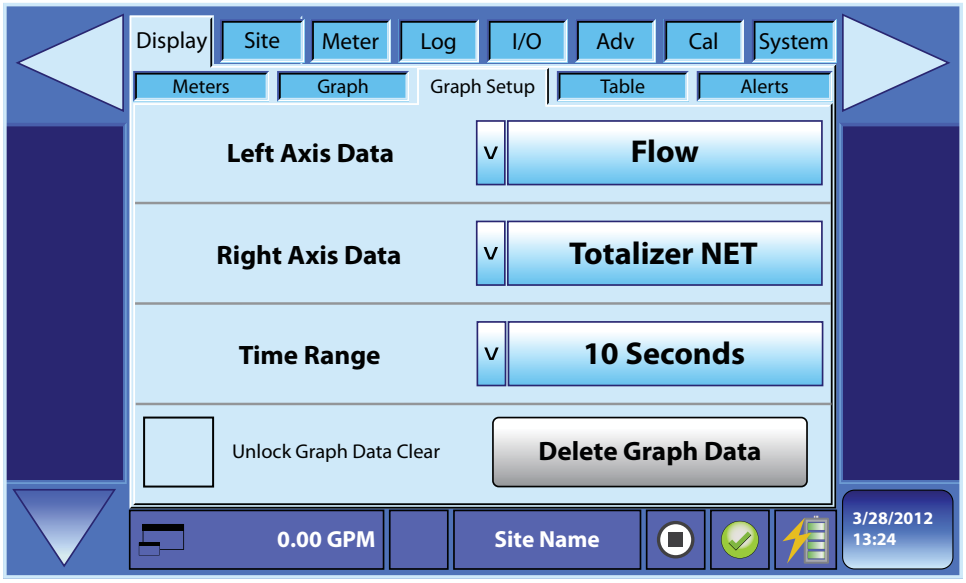


FIGURE 4.11 - GRAPH SETUP PAGE

Left and Right Axis Data - (Choices)

The **Left** and **Right Axis Data** controls allows the choice of parameters to be shown on the respective axis. The valid choices are shown in ***Table 4.2***. When the control is pressed a dropdown menu appears. Choose the desired parameter by highlighting it with the blue box and then press the Set button to load the parameter. Press the × button to save the choice and exit the dropdown.

Flow	Energy POS	TT Delta T	RTD2 Temperature
Totalizer NET	Energy DOP	TT Delta T Raw	RTD Delta Temp
Totalizer POS	TT Flow	TT TOF Bias Raw	IO Voltage In
Totalizer DOP	TT Gain	TT TOF Fluid	IO Digital In
Flow Velocity	TT Quality	TT Fluid SOS	IO Voltage Out
Hybrid Mode	DOP Flow	DOP Flow Velocity	IO Current Out
Reynolds Number	DOP Gain	DOP Frequency	IO Digital Out
Power	DOP Quality	TT Aperture Start	
Energy NET	TT Flow Velocity	RTD1 Temperature	
TT = Transit Time DOP = Doppler			

TABLE 4.2 - Y LT AND Y RT AXIS PARAMETER CHOICES

Time Range - (Choice)

The **Time Range** control allows the choice of time period to be shown on the X axis. The valid choices are shown in ***Table 4.3***. When the control is pressed a dropdown menu appears. Choose the desired parameter by highlighting it with the blue box and then press the Set button to load the parameter. Press the × button to save the choice and exit the dropdown.

10 Seconds	30 Minutes	1 Day	14 Days
30 Seconds	1 Hour	5 Days	1 Month
1 Minute	5 Hours	7 Days	6 Months
10 Minutes	10 Hours	10 Days	1 Year

TABLE 4.3 - TIME AXIS CHOICES

Clear Graph Data

To clear any current graphing data and return the graph scaling to factory defaults first press the **Unlock Graph Data Clear** button. A green check mark should appear and the Delete Graph Data button will then turn red.

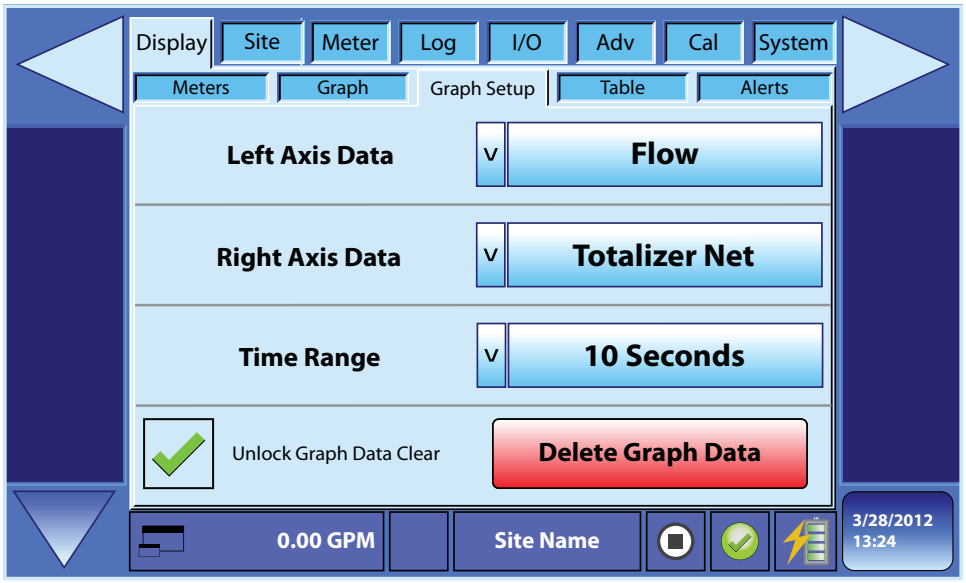


FIGURE 4.12 - CLEARING GRAPHIC DATA

Finally press the red **Delete Graph Data** button. The graph will be reset to factory defaults and the **Delete Graph Data** button will turn gray.

Table Page

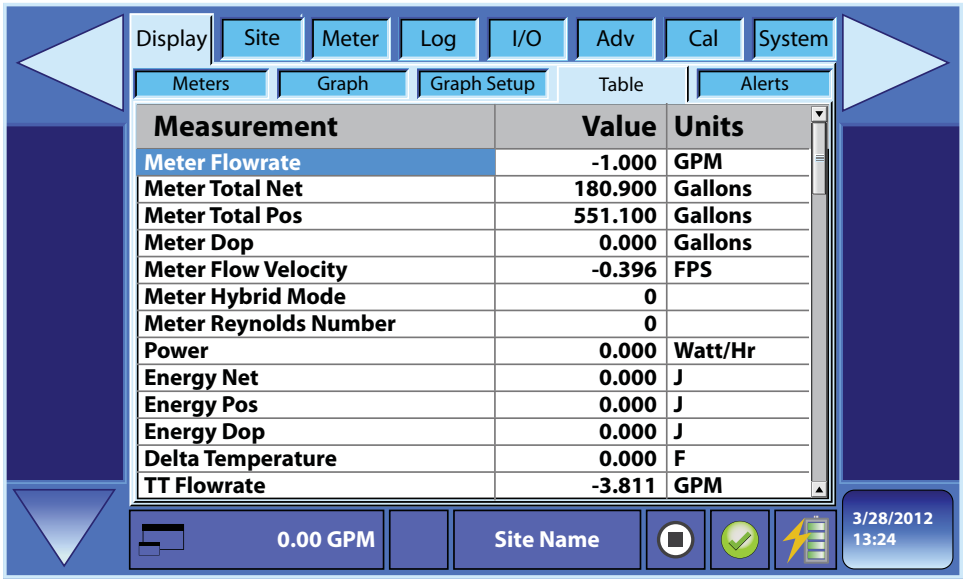


FIGURE 4.13 - TABLE PAGE

The table page shows all the current values the meter is tracking along with their respective units. The scroll bar on the right hand side of the page is used to scroll up or down the list until the required parameter is found.

Alerts Page

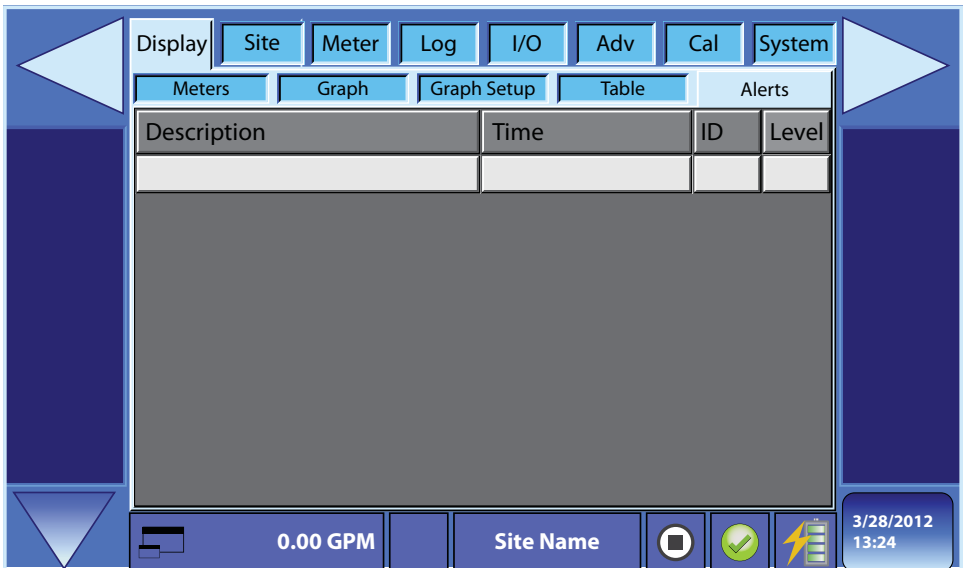


FIGURE 4.14 - ALERTS PAGE

The **Alerts Page** keeps track of any abnormal conditions encountered by the meter. Such things as battery condition, unit temperature issues, low signal quality episodes and fluid sound speed problems are shown in the alerts page until they are resolved.

The severity of the condition is indicated by the color of the description. Red colored descriptions are the most serious with orange being moderate severity and yellow depicting low severity.

Red	Serious	**Immediate Action Required**
Orange	Moderate	**Cautionary**
Yellow	Minor	**Minor**

SITE GROUP

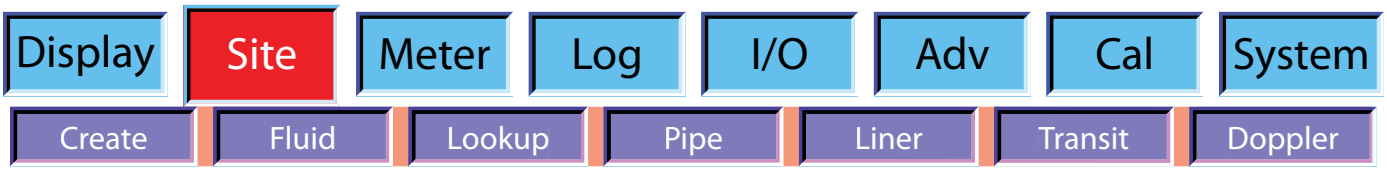


FIGURE 4.15 - SITE GROUP

The Site group is used to create and store individual metering locations. Each new location can be stored with all the setup parameters for that particular site making periodic measurements less time consuming.

New sites can be created in two different ways. A site can be created using the factory default settings or the settings the meter is currently using. In either case settings can be changed for that particular site whenever necessary.

Create Page

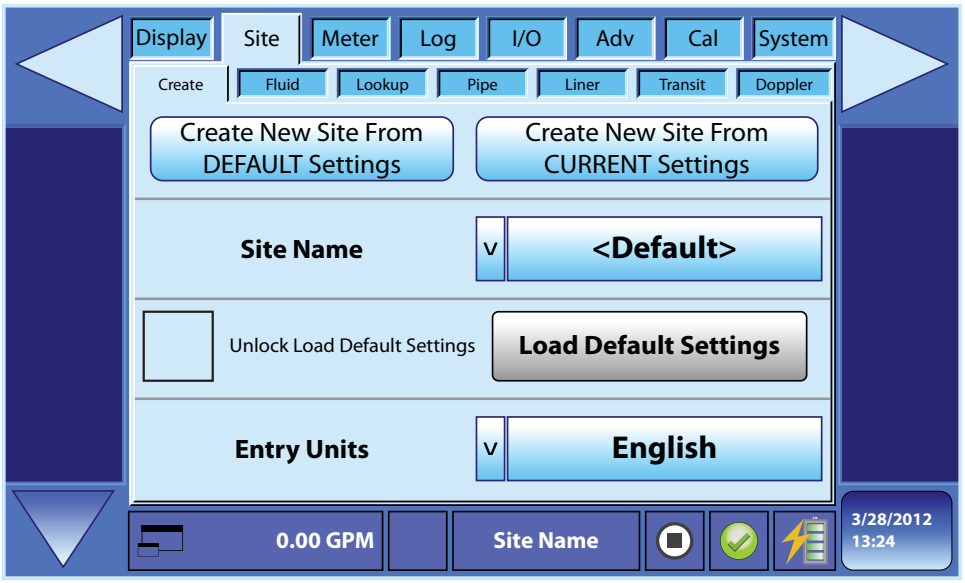


FIGURE 4.16 - SITE PAGE CONFIGURATION

Create New Site From DEFAULT Settings - (Alpha-numeric Entry)

To create a new site using the meters default settings:

1) Press the "**Create New Site From DEFAULT Settings**" button. When this button is pressed the alpha numeric keypad as shown in ***Figure 2.5*** will pop-up. Type in a unique name for the site and then press "**Create Site**" button.

The meters default settings will be copied from memory and stored under the new site name. The "**Site Name**" button will also show the new site name assigned.

NOTE: *The site name is restricted to 45 characters.*

Create New Site From CURRENT Settings - (Alpha-numeric Entry)

To create a new site using the meters current settings:

1) Press the "**Create New Site From CURRENT Settings**" button. When this button is pressed the alpha numeric keypad as shown in ***Figure 2.5*** will pop-up. Type in a unique name for the site and then press "**Create Site**" button.

The meters current settings will be and stored under the new site name. The "**Site Name**" button will also show the new site name assigned.

This function is used when the meter is completely set up and operating as required. Once all parameters have been optimized all the settings are saved under the new site name making the setup of the same site much faster in the future.

NOTE: *The site name is restricted to 45 characters.*

Site Name - (Choice)

The "**Site Name**" function is used to select an existing site name. It is used in conjunction with the "**Create New Site**" functions to select a site that has already been programmed into the meter. When the "Site Name" button is pressed a dropdown list of saved sites are displayed.

Press the desired site name and then press the Set button to activate the previously saved site. If a large number of sites have been stored use the scroll bars to locate the site, highlight the site name, and press Set. The dropdown menu can be exited without making any changes by pressing the × button

Load Factory Defaults - (Choice)

Loading the factory defaults will return the meter to a known state for most of the customer selectable parameters. The default settings do not included basic setup parameters such as pipe size, pipe type, fluid type etc. For a complete list of default parameters see the **Cal Group► Factory Page.**

To prevent unintended loading of the default settings the "**Unlock Load Default Settings**" box must have a check mark in it to activate the "**Load Default Settings**" button.

First press the "**Unlock Load Default Settings**" button. A green check mark should appear and the "**Load Default Setting**" button will turn orange. Press the "**Load Default Settings**" button to confirm loading the default settings. When the settings have been loaded the "**Load Default Settings**" button will return to a gray color and the green check mark will disappear from the "**Unlock Load Default Settings**" box.

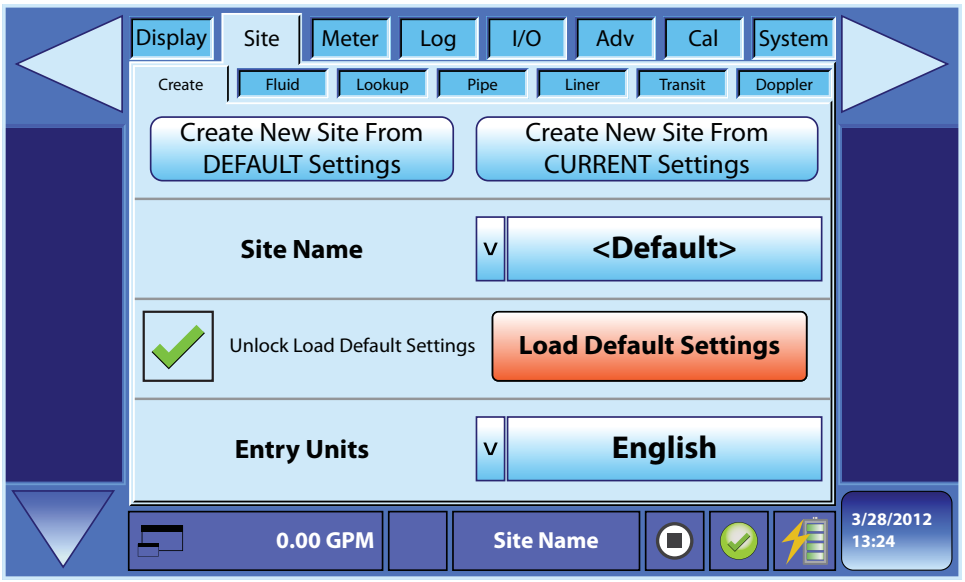


FIGURE 4-17 - LOAD DEFAULT SETTINGS ENABLED

Entry Units - (Choice)

Select **English** if configurations (pipe sizes, etc.) are to be made in inches. Select **Metric** if the meter is to be configured using millimeters.

***NOTE:** The "**Entry Units**" are independent of the choices made to display flow rate, total, energy readings etc. For example the meter can be configured for a 2" ANSI pipe and still have the rate displayed in LPM.*

The **English/Metric** selection will also configure the DXN to display sound speeds in pipe materials and liquids as either feet per second (**FPS**) or meters per second (**MPS**), respectively.

IMPORTANT!: *If the **Entry Units** choice has been changed from **English** to **Metric** or from **Metric** to **English**, the entry must be saved by doing a power down and then a power up in order for the DXN to initiate the change in operating units. Failure to save and reset the instrument will lead to improper transducer spacing calculations and an instrument that may not measure properly.*

Fluid Page

Select "**Site**" from the Group bar at the top of the screen. When the site pages appear select the "**Fluid**" page to enter information about the type of fluid to be used.

NOTE: *This page is also used to start the entry of information about a custom fluid.*

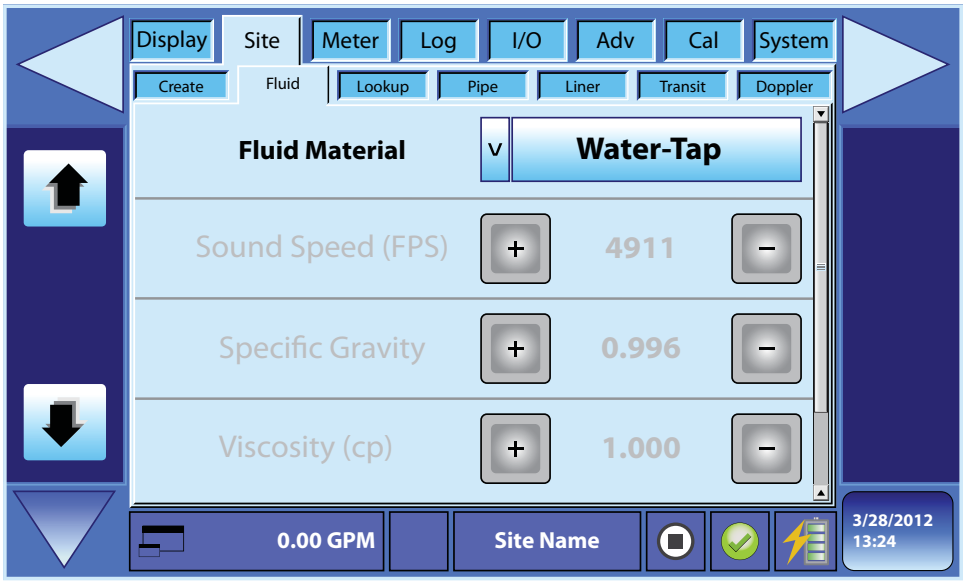


FIGURE 4.18- STANDARD TRANSIT TIME FLUID SELECTION SCREEN

NOTE: *Scroll bars to the right of the menu choices indicates there is more information than can be seen on one page alone.*

Navigation in the fluid page is accomplished using either the Up/Down arrow keys located on the left hand side of the screen or the scroll bar to the right of the decrement (-) buttons on the right.

Fluid Material - (Choice)

Choose the fluid material from the combo box dropdown. The built in choices are shown in ***Table 4.4***.

Water - Tap	Ethanol	Milk 4%	Water Distilled
Water - Gray	Gasoline	Oil Diesel	Water Sea
Acetone	Glycerin	Oil Hydraulic (Petro)	Custom
Ammonia	Isopropanol	Oil Lubricating	
Benzene	Kerosene	Oil Motor (SAE 20/30)	
Brine	Methanol	Stoddard Solvent	

TABLE 4.4 - FLUID MATERIAL CHOICES

This list is provided as an example. Additional liquids are added periodically. Select the appropriate liquid from the list or select **Custom** fluid if the liquid is not listed.

If a fluid material was chosen from the "**Fluid Material"** list, a nominal value for speed of sound, specific gravity, viscosity, and specific heat capacity for that material will be automatically loaded. If actual values are known for the specific fluid system and those values vary from the automatically loaded value, the value can be revised by selecting the **Custom** fluid choice and entering the appropriate values.

Custom Fluids

If "**Custom**" was chosen from the Fluid Material dropdown the following parameters must be entered.

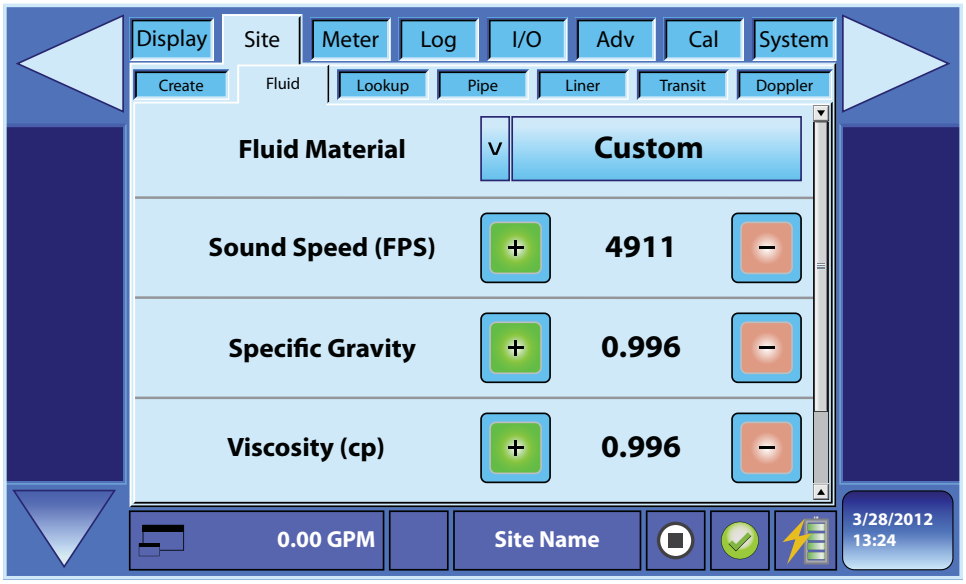


FIGURE 4.19 - CUSTOM FLUID SETUP

Custom Fluid Sound Speed - (Numeric Value)

Enter the sound speed of the custom fluid. If "**English**" was chosen for the "**Entry Units**" enter the sound speed in FPS. If "Metric" was chosen the sound speed is entered in MPS. The fluid sound speed can also be obtained directly from the meter if the transducers are already correctly positioned and the signal quality is above 7. This value is available by selecting TT SOS in one of the data panels. See ***Display Group ► Meters Page***.

Custom Fluid Specific Gravity - (Numeric Value)

DXN flow meters utilize pipe size, specific gravity and viscosity to calculate Reynolds numbers. Since the Reynolds number influences flow profile, the DXN has to compensate for the relatively high velocities at the pipe center during transitional or laminar flow conditions. The "**Specific Gravity**" entry is utilized in the calculation of Reynolds and the resultant compensation values.

The specific gravity entry allows adjustments to be made to the specific gravity (density relative to water) of the liquid.

As stated previously specific gravity is utilized in the Reynolds correction algorithm. It is also utilized if mass flow measurement units are selected for rate or total.

If a fluid was chosen from the "**Fluid Material**" list, a nominal value for specific gravity in that media will be automatically loaded. If the actual specific gravity is known for the application fluid and that value varies from the automatically loaded value, the value can be revised.

If a custom fluid was entered a specific gravity will need to be entered if mass flows are to be calculated. A list of alternate fluids and their associated specific gravities is located in the Appendix of this manual.

Dynamic Viscosity - (Numeric Value entered in cP)

f a fluid was chosen from the "**Fluid Material"** list, a default viscosity will be automatically loaded. If the actual viscosity of the liquid is known or it differs from the default value, the value can be revised. A list of alternate fluids and their associated viscosities is located in the Appendix of this manual

Viscosity is a measure of the resistance of a fluid to deform under either shear stress or extensional stress. It is commonly perceived as "thickness", or resistance to flow. Viscosity describes a fluid's internal resistance to flow and may be thought of as a measure of fluid friction.

The cgs (centimeters - grams - seconds) system uses a unit of dynamic viscosity called the poise (P). It is more commonly expressed, particularly in ASTM standards, as centipoise (cP). The centipoise is commonly used because water has a viscosity of 1.0020 cP (at 20 °C; the closeness to one is a convenient coincidence).

The DXN uses dynamic viscosity, expressed in cP, in the calculation of Reynolds numbers and its Reynolds correction algorithm.

Specific Heat Capacity - (Numeric Value entered in kJ/kg x °K)

Allows adjustments to be made to the specific heat capacity of the liquid.

If a fluid was chosen from the "**Fluid Material"** list, a default specific heat will be automatically loaded. If the actual specific heat of the liquid is known or it differs from the default value, the value can be revised. A list of alternate fluids and their associated specific heat capacities is located in the Appendix of this manual. Enter a value that is the mean of both pipes.

Heat capacity or thermal capacity, is the physical quantity that characterizes the amount of heat required to change a substance's temperature by a given amount. The SI unit of heat capacity is expressed in joules per degree kelvin (J/°K).

The specific heat capacity, often simply called specific heat, is the heat capacity per unit mass of a material. Occasionally, in engineering contexts, a volumetric heat capacity is used. The quantity used in the DXN is calculated as:

$$Specific\ Heat\ Capacity = \frac{kJ}{kg\ x\ °K}$$

Lookup Page

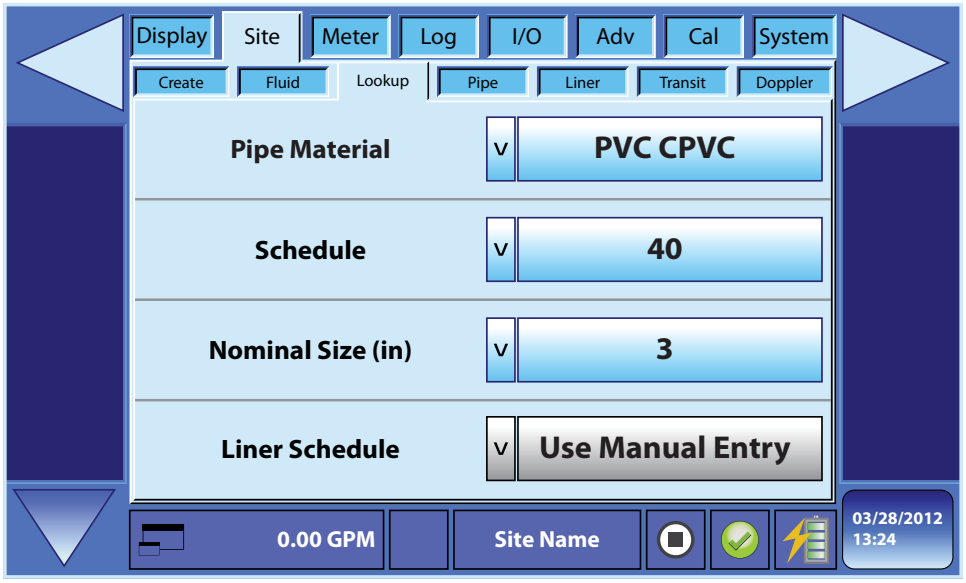


FIGURE 4.20 - LOOKUP

The **Lookup** page provides access to the DXN's built in pipe tables. The pipe lookup tables use "cascading" choices to make selections. When the Pipe Material is chosen the Schedule/Class entry becomes available. When the Schedule/Class entry is made the Nominal Size choice becomes active.

The **Site Group► Lookup Page** and **Site Group ► Pipe Page** dropdown's interact with each other. If a particular parameter is selected in one dropdown menu it will be unavailable in the other dropdown.

The selection of "**Use Manual Entry**" enables the entry of non-standard parameters using the **Site Group ► Pipe Page** dropdown. The choice of Use Manual Entry will unlock the Pipe Material, Pipe OD, and Pipe Wall [Thickness] inputs (See ***Figure 4.21***).

Pipe Material - (Choice)

Choose the pipe material from the combo box dropdown.

Manual Dimension Entry	Iron - Cast	St Steel 302/303
Acrylic	Iron - Ductile	St Steel 304
Aluminum	Fiberglass Epoxy	St Steel 304L
Asbestos Cement	Glass Pyrex	St Steel 316
Brass (Naval)	Nylon	St Steel 347
Carbon Steel	HD Polyethylene	St Steel 410
Concrete	LD Polyethylene	St Steel 430
Copper	Polypropylene	PFA
CuNi 70Cu 30Ni	PVC CPVC	Titanium
CuNi 90Cu 10Ni	PVDF	Other

TABLE 4.5 - PIPE MATERIAL CHOICES

NOTE: *This list is provided as an example. Additional pipe materials are added periodically.*

Pipe Schedule/Class - (Choice)

The choice of pipe material determines the choices available in the Schedule/Class dropdown menu. For example if a pipe material that is governed by ANSI standards is selected, the menu label will show "Schedule" and the schedule choices will be appropriate for ANSI pipe. If Cast Iron is chosen the label "Class" will be shown instead of "Schedule" indicating the pipe material is categorized in classes.

Nominal Size - (Choice)

This selection allows various standard or "Nominal" pipe sizes to be chosen. Simply choose one of the nominal values from the dropdown menu.

Liner Schedule - (Restricted Choice)

Certain combinations of "**Pipe Material**", "**Class**", and "**Nominal Size**" have liner information built into the pipe specification. This condition is usually found in ductile iron classes, 6 inches and up. If a ductile pipe with "built in" liner is used a selection of either "Standard" or "Double" can be made.

NOTE: *The choice of Standard or Double will disable the* **Site ► Liner** *menu item.*

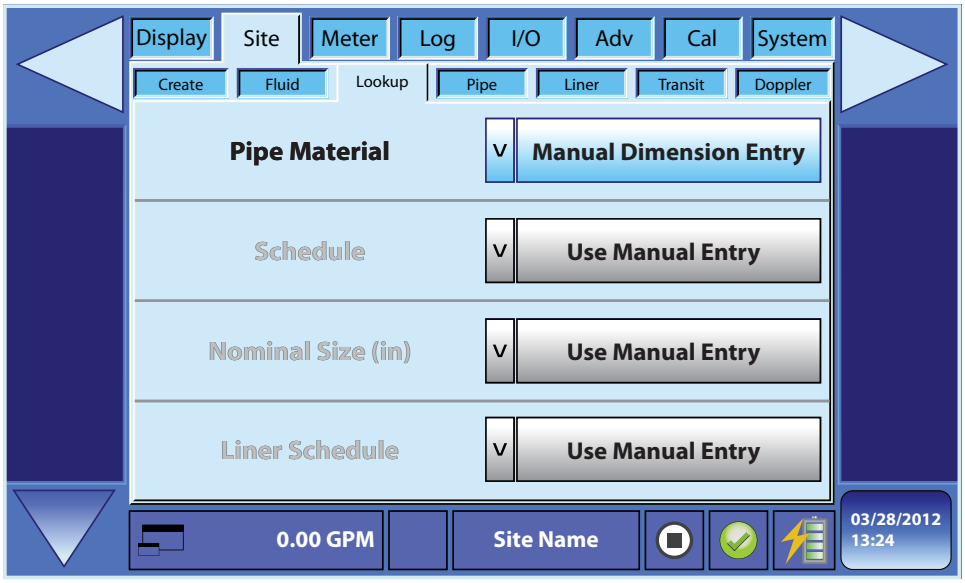


FIGURE 4.21 - LOOKUP PAGE MANUAL ENTRY

If **Manual Dimension Entry** is selected in **Site Group ► Lookup Page** (see ***Figure 4.20***) screen the parameters in the **Site Group ► Pipe Page** screen will be available for user input as in ***Figure 4.22***

NOTE: *If the* **Site Group ► Lookup Page** *feature is used the values are automatically loaded into the parameter choices in the* **Site Group ► Pipe Page** *screen but Pipe OD and Pipe Wall [Thickness] are still available for changes.*

Pipe Page

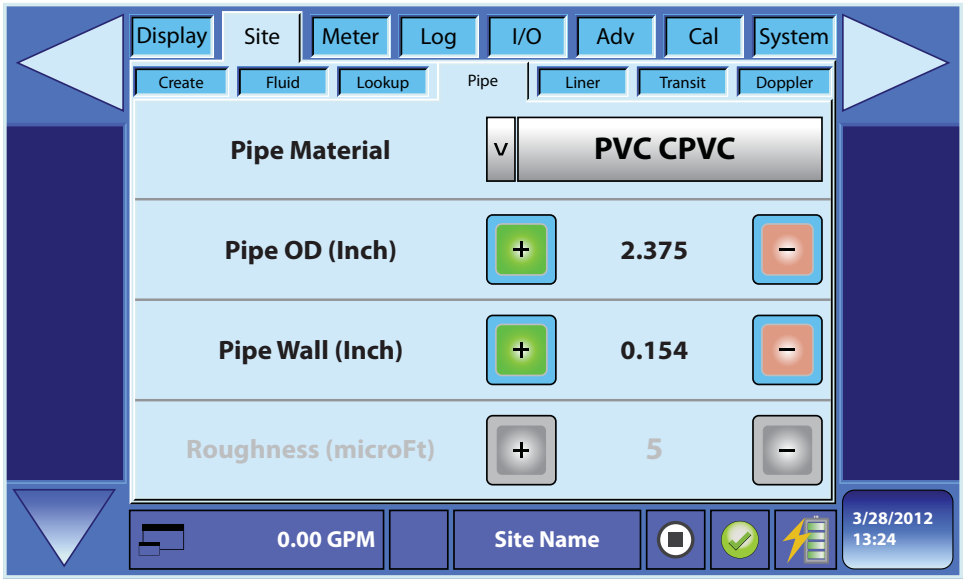


FIGURE 4.22 - PIPE PAGE FROM NOMINAL ENTRY

This page is used for the manual entry of pipe parameters. If the lookup function (**Site Group ► Lookup Page)** was used, nominal values for Pipe OD, Pipe Wall [Thickness], and Roughness are automatically entered. If the actual values of the pipe differ from the ones automatically entered go back to **Site Group ► Lookup Page** and select "**Manual Dimension Entry**" to enable entry of non-standard parameters. The choice of Manual Dimension Entry will unlock the Pipe Material, Pipe OD, and Pipe Wall [Thickness] inputs as shown in ***Figure 4.22***.

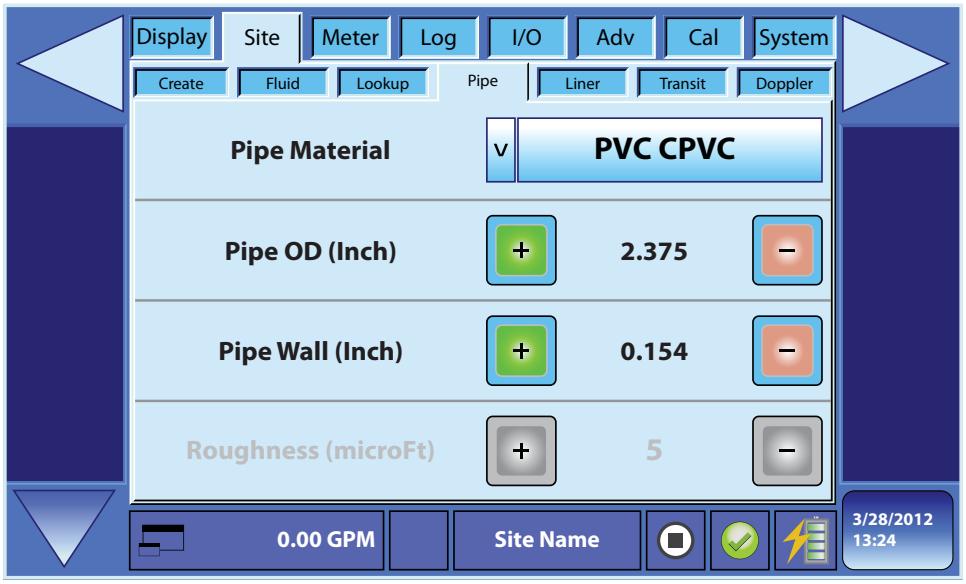


FIGURE 4.23 - PIPE PAGE ALLOWING MANUAL ENTRY

Pipe Material

Select the appropriate pipe material from the list or select "**Other"** if the material is not listed.

If a pipe material was chosen from the "**Pipe Material"** list, a nominal value for speed of sound in that material and the pipe roughness will be automatically loaded. If the actual sound speed is known for the application piping system and that value varies from the nominal value loaded, the value can be revised.

If "**Other"** was chosen as a pipe material, then a "**Pipe Sound Speed**" must also be entered.

Pipe OD - (Numeric Value)

Next enter the "**Pipe OD**" (outside diameter).

Enter the pipe outside diameter in inches if "**English"** was selected as the "**Entry Units"**; in millimeters if "**Metric"** was selected.

NOTE: *Charts listing popular pipe sizes have been included in the* ***Appendix*** *of this manual. Correct entries for pipe O.D. and pipe wall thickness are critical to obtaining accurate flow measurement readings.*

Pipe Wall [Thickness] - (Numeric Value)

The "**Pipe Wall**" thickness is the value of the actual pipe wall thickness excluding any liner that may be present.

NOTE: *Accurate values for "****Pipe OD"*** *and "****Pipe Wall****" thickness are necessary for accurate computation of the volumetric flow rate. Without accurate pipe data, flow rates will be in error by the difference between the actual pipe cross sectional area and the area calculated using the incorrect pipe OD and/or pipe wall thickness values.*

[Pipe] Roughness - (Numeric Value in Micro Feet)

Surface roughness is the measure if the small surface irregularities in the pipe surface and is composed of three components: roughness, waviness and form. These are the result of the manufacturing process employed to create the surface.

Surface roughness average (Pipe R), also known as arithmetic average (AA) is rated as the arithmetic average deviation of the surface valleys and peaks expressed in micro inches (µ inches).

The DXN provides flow profile compensation in its flow measurement calculation. One of the components of that calculation is roughness. The ratio of average surface imperfection as it relates to the pipe internal diameter is used in this compensation algorithm and is found by using the following formula:

$$Pipe\ R = \frac{RMS\ Measurement\ of\ the\ Pipes\ Internal\ Wall\ Surface}{Inside\ Diameter\ of\ the\ Pipe}$$

NOTE: *A microinch (µ inch) is* $\frac{1}{1{,}000{,}000}$ *of an inch.*

If a pipe material was chosen from the "**Pipe Material"** list, a nominal value for relative roughness in that material will be automatically loaded.

If the pipe has a roughness value that differs from standard for the pipe type, a custom value can be entered using the "**Roughness**" controls.

Pipe Sound Speed (Value)

If "Other" was chosen from the "Pipe Material" list a "Pipe Sound Speed" control will become available at the bottom of the pipe page. If the "**Entry Units"** are in "**English"** the "Pipe Sound Speed" is entered in FPS. For "**Metric"** units the pipe sound speed is in MPS.

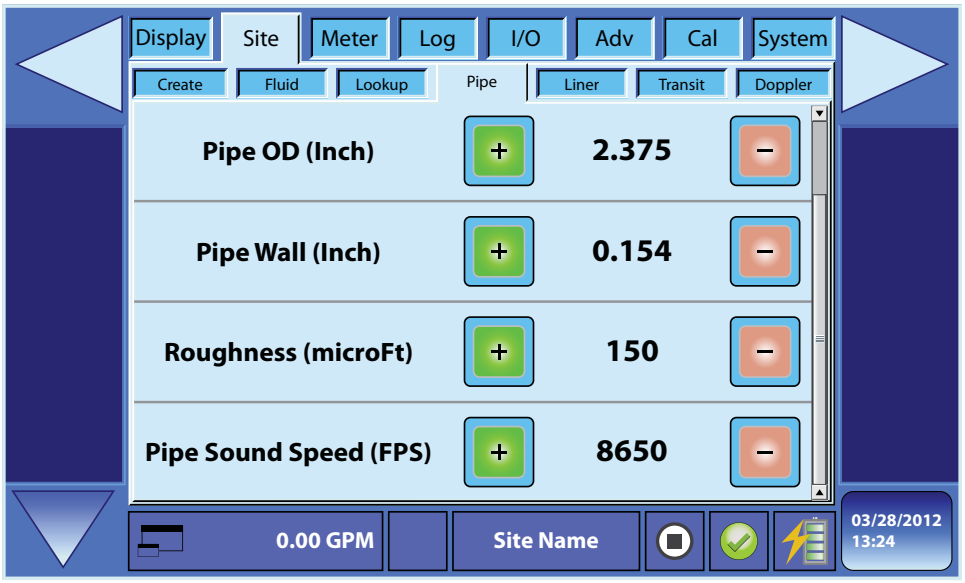


FIGURE 4.24 - PIPE SOUND SPEED CONTROL

Liner Page

FIGURE 4.25 - LINER PAGE

Liner Material - (Choice)

Choose the pipe liner material from the combo box dropdown.

The following list is provided as an example. Additional materials are added periodically. Select the appropriate material from the list or select "**Other"** if the liner material is not listed.

None	Mortar	Polystyrene	Other
Acrylic	HD Polyethylene	Rubber	
Asbestos Cement	LD Polyethylene	Tar Epoxy	
Ebonite	Polypropylene	Teflon® (PFE)	

TABLE 4.6 - LINER MATERIAL CHOICES

If a liner was chosen from the "**Liner Material"** list, a nominal value for speed of sound and pipe roughness in that media will be automatically loaded. If the actual sound speed rate or roughness is known for the pipe liner and that value varies from the automatically loaded values, these values can be revised.

Liner Wall [Thickness] - (Numeric Value)

Enter the liner wall thickness in inches if "**English"** was selected as "**Entry Units"**; in millimeters if "**Metric"** was selected.

NOTE: *if a liner is present an accurate value for "**Liner Wall**" thickness is necessary for accurate computation of the volumetric flow rate. Without accurate liner data flow rates will be in error by the difference between the actual pipe cross sectional area and the area calculated using the incorrect pipe liner thickness.*

[Liner] Roughness - (Numeric Value in Micro Feet)

If a liner material was chosen from the **Liner Material** list, a nominal value for relative roughness in that material will be automatically loaded. If the actual roughness is known for the application liner and that value varies from the automatically loaded value, the value can be revised.

Liner Sound Speed - (Numeric Value)

Allows adjustments to be made to the speed of sound value, shear or transverse wave, for the pipe wall. If the "**Entry Units"** value was set to "**English**"**:**, the entry is in FPS (feet per second). Metric entries are made in MPS (meters per second).

If "**Other**" was chosen from the "**Liner Material**" list a "Liner Sound Speed" control will become available at the bottom of the liner page. If the "**Entry Units"** are in "**English"** the "Liner Sound Speed" is entered in FPS. For "**Metric"** units the liner sound speed is in MPS.

Transit Page

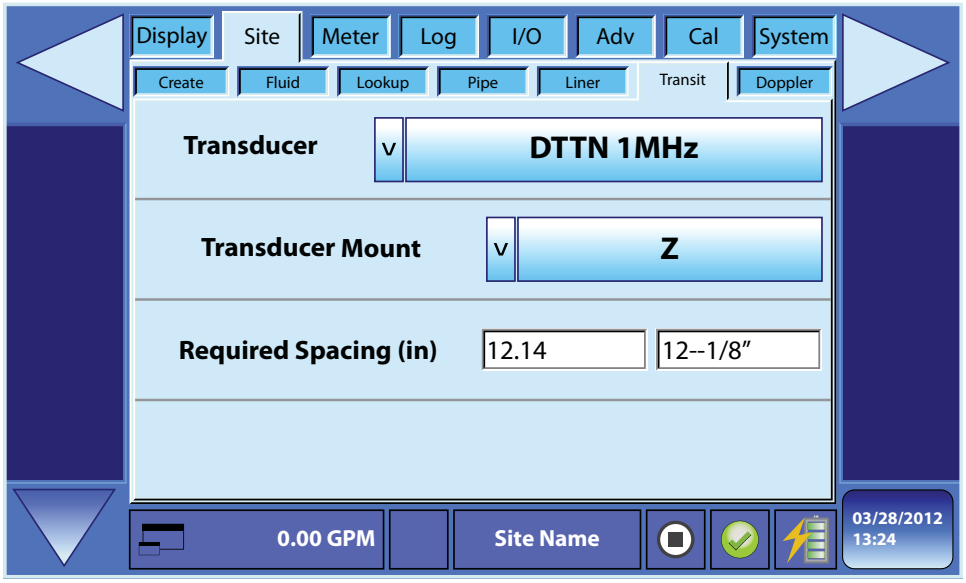


FIGURE 4.26 - TRANSIT PAGE

Transducer [Transducer Type and Frequency] - (Choice)

DTTN 1 MHz	Standard Transducers	DTTL 0.5 MHz	Large Pipe Transducers
DTTH 1 MHz	High Temperature Transducers	DTTSU 2 MHz	Small Pipe Transducers

TABLE 4.7 TRANSDUCER TYPES AND FREQUENCIES

Transducer transmission frequencies are specific to the type of transducer. In general the DTTL 500 KHz (0.5 M Hz) transducers are used for pipes greater than 24 inches (600 mm). DTTN and DTTH, 1 MHz transducers, are for intermediate sized pipes between 2 inches (50 mm) and 24 inches (600 mm). The DTTSU uses a 2 MHz transmission frequency and is used for pipe sizes between ½ inch (13 mm) and 2 inches (50 mm).

Transducer Mount [Transducer Mounting Method] - (Choice)

Selects the mounting pattern for the transducers. The selection of an appropriate mounting pattern is based on pipe and liquid characteristics.

DXN transit time flow meters can be used with four different transducer types: DTTN, DTTH, DTTL, and DTTSU. The DTTN, DTTH or DTTL transducer sets consist of two separate sensors that function as both ultrasonic transmitters and receivers. DTTSU transducers integrate both sensors into one assembly. All transducers require the separation of the transmit/receive modules be adjusted to the spacing value calculated during the DXN setup. DTTN and DTTL transducers are clamped on the outside of a closed pipe at a specific distance from each other.

The DTTN and DTTL transducers can be mounted in:

W-Mount where the sound traverses the pipe four times. This mounting method produces the best relative travel time values but the weakest signal quality.
V-Mount where the sound traverses the pipe twice. **V**-Mount is a compromise between travel time and signal quality.
Z-Mount where the transducers are mounted on opposite sides of the pipe and the sound crosses the pipe once. **Z**-Mount will yield the best signal quality but the smallest relative travel time.

See ***Table 3.1*** for transducer mounting mode selection starting points.

Required Spacing - [Transducer Spacing] (Value Calculated by Meter)

NOTE: *This value is calculated by the firmware after all pipe parameters have been entered.*

This value represents the one-dimensional linear measurement between the transducers (the upstream/downstream measurement that runs parallel to the pipe). The value is in inches if "**English"** was selected as "**Entry Units"**and millimeters if "**Metric"** was selected. This measurement is taken between the lines which are scribed into the side of the transducer blocks.

If the transducers are being mounted using the transducer track assembly (DTTN only), a measuring scale is etched into the track. Place one transducer at 0 and the other at the appropriate measurement.

Doppler Page

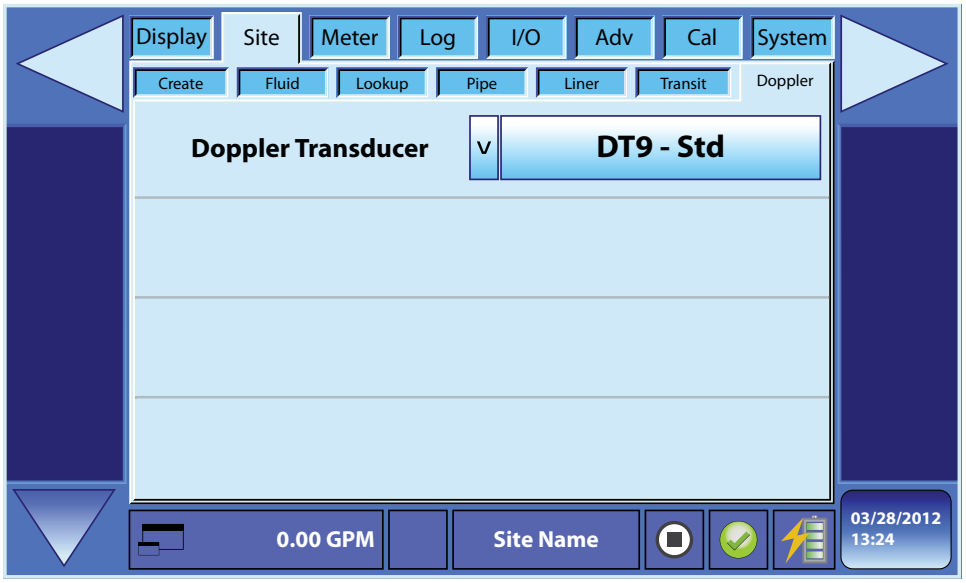


FIGURE 4.27 - DOPPLER TRANSDUCER SELECTION

If the Doppler measuring mode is to be used, the proper Doppler transducers must be chosen. At this time the DT94 series transducers are the only Doppler transducers supported.

METER GROUP

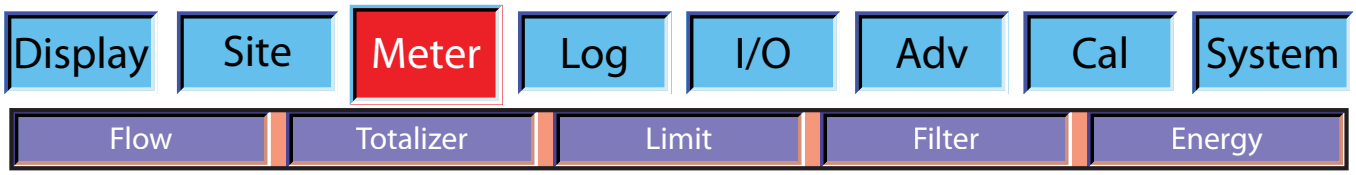


FIGURE 4.28 - METER GROUP

Select the "**Meter Group**" from the Group bar at the top of the screen. When the Meter pages appear select the flow page to enter information about the flow units to be used.

Flow Page

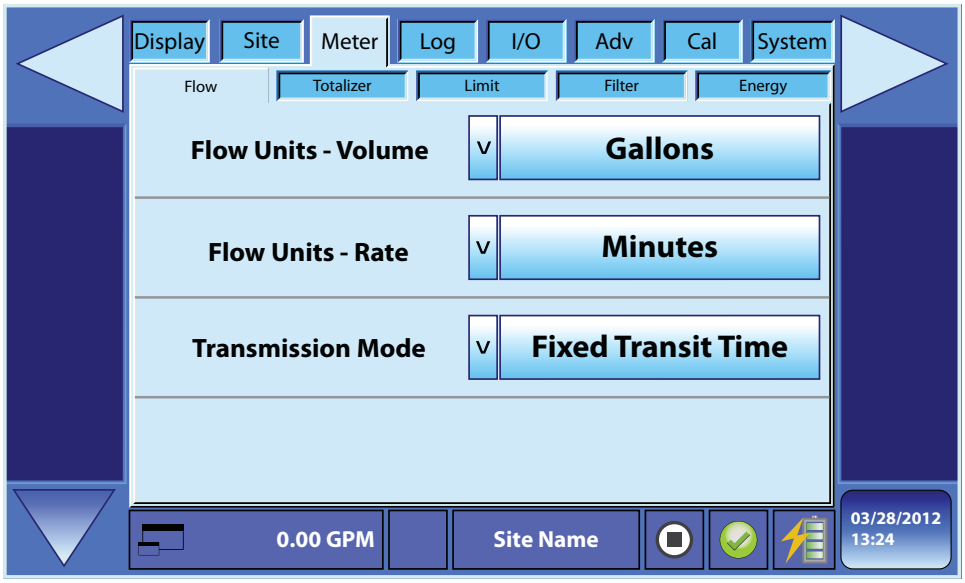


FIGURE 4.29 - FLOW UNITS SETUP

Flow Units Volume [Engineering Units for Flow Rate] - (Choice)

Gallons	Oil Barrels (42 Gallons)	British Thermal Units
Liters	Liquid Barrels (31.5 Gallons)	Thousands of BTUs
Millions of Gallons	Feet	Millions of BTUs
Cubic Feet	Meters	Tons
Cubic Meters	Pounds	Kilojoule
Acre Foot	Kilograms	Kilowatt

TABLE 4.8 - FLOW UNITS

Select a desired engineering unit for flow rate measurements.

Flow Units Rate - Time Interval for Flow Rate (Choice)

The flow interval can be any of the following:

Seconds
Minutes
Hours
Days

Select a desired time unit for flow rate measurements.

Transmission Mode [The Type of Ultrasonic Signal The Transmitter Generates] - (Choice)

The Transmission Mode can be any of the following:

Hybrid - The DXN monitors the fluid conditions and determines automatically when to switch between Doppler and transit time modes.
Transit Time - The DXN always operates in transit time mode.
Doppler - The DXN always operates in Doppler mode.

Totalizer Page

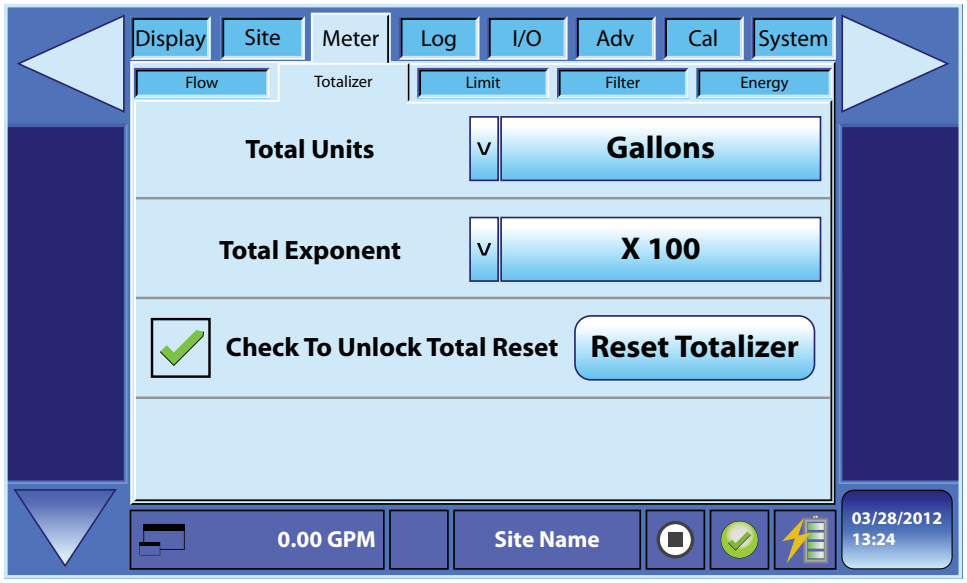


FIGURE 4.30 - TOTALIZER SETUPS

Total Units -- Totalizer Units

Gallons	Pounds
Liters	Kilograms
Millions of Gallons	British Thermal Units
Cubic Feet	Thousands of BTUs
Cubic Meters	Millions of BTUs
Acre Feet	Tons
Oil Barrels	Kilojoule
Liquid Barrels	Kilowatt
Feet	Megawatt
Meters	

TABLE 4.9 - TOTALIZER UNITS

Select a desired engineering unit for flow accumulator (totalizer) measurements.

Total Exponent [Flow Totalizer Exponent Value] - (Choice)

Utilized for setting the flow totalizer exponent. This feature is useful for accommodating a very large accumulated flow or to increase totalizer resolution when flows are small (displaying fractions of whole barrels, gallons, etc.) The exponent is a $\times 10^n$ multiplier, where "n" can be from –1 (× 0.1) to +6 (× 1,000,000). ***Table 4.10*** should be referenced for valid entries and their influence on the display.

Exponent	Display Multiplier
E-1	× 0.1 (÷10)
E0	× 1 (no multiplier)
E1	× 10
E2	× 100
E3	× 1,000
E4	× 10,000
E5	× 100,000
E6	× 1,000,000

TABLE 4.10 - EXPONENT VALUES

Totalizer Reset - (Yes/No)

Totalizer Reset is used to reset all totalizers back to zero. To prevent inadvertent resets a totalizer lock is provided.

To reset the totalizers first tap the "**Check To Unlock Total Reset**" button (See ***Figure 4.28***). A check mark will appear in the within the button. The "**Reset Totalizer**" button previously grayed out will now become active. Press the "**Reset Totalizer**" button to return all totalizers to zero.

NOTE: *The DXN also has a hardware totalizer reset function. See* ***Figure 5.3****.*

Limit Page

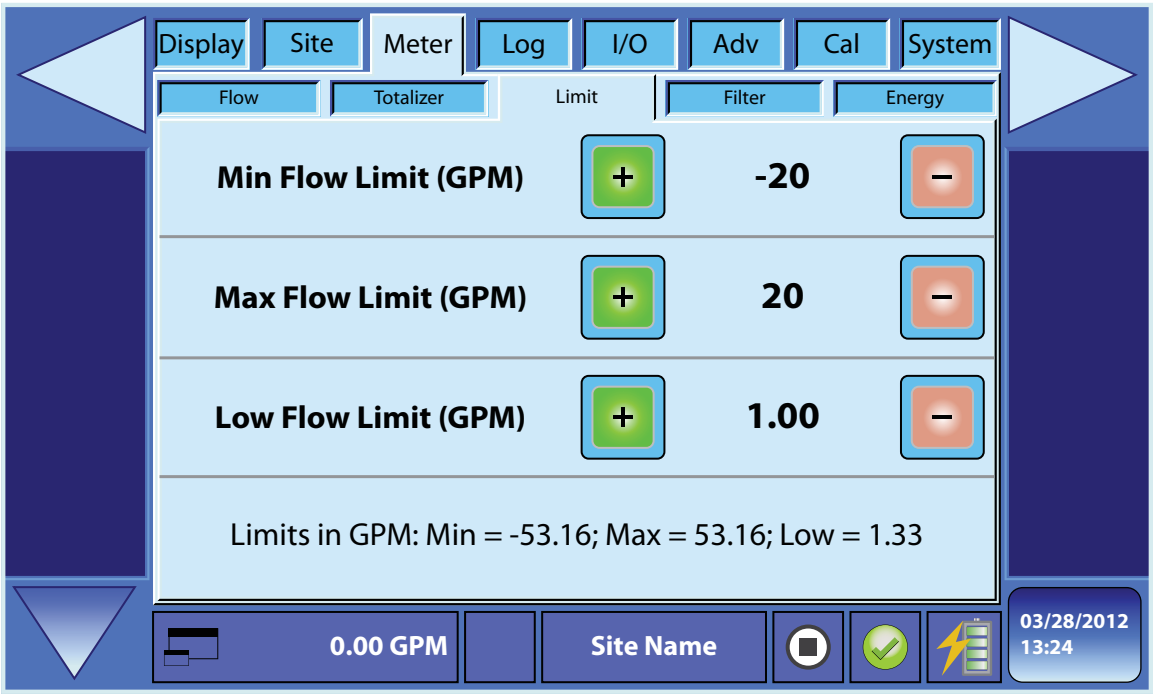


FIGURE 4.31 - LIMIT VALUE SETTINGS

Min Flow Limit [Minimum Flow Rate Settings] - (Value)

A minimum rate setting is entered to establish filter software parameters and the lowest rate value that will be displayed. Volumetric entries will be in the Flow Units selected in the **Meter Group ► Flow Page**. For unidirectional measurements, set "**Min Flow Limit"** to zero. For bidirectional measurements, set "**Min Flow Limit"** to the highest negative (reverse) flow rate expected in the piping system.

NOTE: *The flow meter will not display a flow rate at flows less than the "**Min Flow Limit"** value. As a result, if the "**Min Flow Limit "** is set to a value greater than zero, the flow meter will display the "**Min Flow Limit"** value, even if the actual flow/energy rate is less than the set "**Min Flow Limit"**.*

*For example, if the "**Min Flow Limit"** is set to 25 and the actual rate is 0, the display will indicate 25. Another example, if the "**Min Flow Limit"** is set to -100 and the actual flow is -200, the meter will indicate -100. This can be a problem if the meter's "**Min Flow Limit"** is set to a value greater than zero because at flows below the **Min Flow Limit the rate display will show zero flow, but the totalizer which is not affected by the Min Flow Limit setting will keep totalizing.***

Max Flow Limit [Maximum Flow Rate Settings] - (Value)

A maximum volumetric flow rate setting is entered to establish filter software settings. Volumetric entries will be in the Rate Units selected in the **Meter Group ► Flow Page**. For unidirectional measurements, set "**Max Flow Limit"** to the highest (positive) flow rate expected in the piping system. For bidirectional measurements, set "**Max Flow Limit"** to the highest (positive) flow rate expected in the piping system.

Low Flow Limit [Low Flow Cut-off] - (Value)

A "**Low Flow Limit"** entry is provided to allow very low flow rates (that can be present when pumps are off and valves are closed) to be displayed as zero flow. Typical values that should be entered are between 1.0% and 5.0% of the flow range between "**Min Flow Limit"** and "**Max Flow Limit"**.

The Low Flow Limit can also be thought of as the minimum flow rate that the meter will give reliable readings.

Filter Page

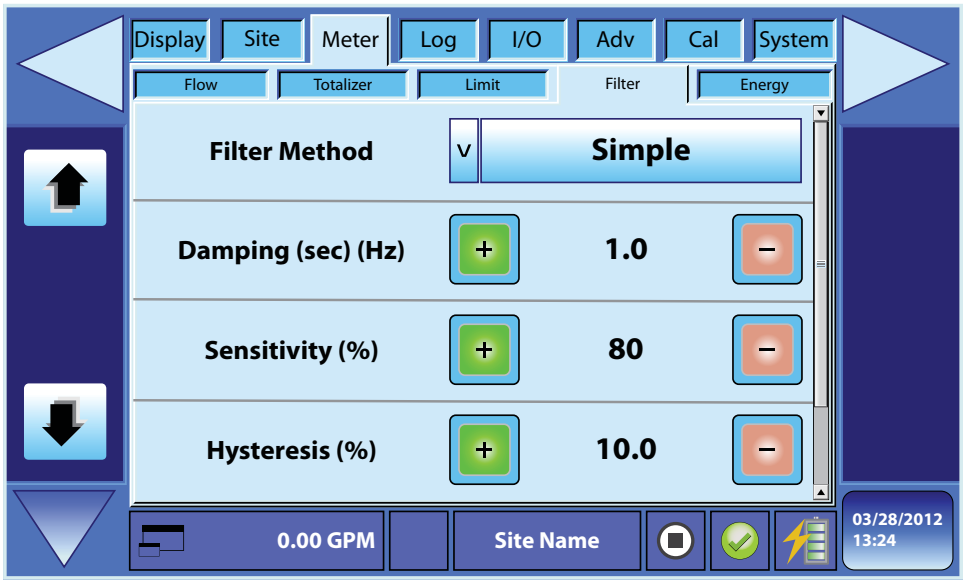


FIGURE 4.32 - FILTER SETTINGS

Filter Method - (Choice)

The DXN can be set for several levels of signal filtering. They are:

None - This selection imposes no filtering on the signal from the transducers.

Simple - Simple filtering uses Damping (no bad data rejection) to filter the flow values.

Simple with Rejection - Simple filtering with rejection uses Damping and Bad Data Rejection to filter the flow data.

Adaptive - Adaptive filtering allows the DXN's software routines to alter the filtering depending on how variable the signal from the transducers is. This filter used a combination of Damping, Bad Data Rejection, Sensitivity, and Hysteresis to modify the flow input data.

Automatic Adaptive - The automatic adaptive setting puts the DSP in complete control of setting filtering parameters.

Damping - (Numeric Time Value) [Range 0 to 10 seconds]

Dampining is the approximate amount of time the filtering routines use to attain a 99% stable rate value. Generally the higher the damping value the more stable the rate readings are but at the expense of response time.

Sensitivity - (Numeric Value in %) [Range 0 to 100]

The sensitivity adjustment determines how fast the adaptive filtering will respond to a change in rate. Increasing the sensitivity has the effect of decreasing the filtering allowing the display to respond to rate changes more rapidly.

Hysteresis - (Numeric Value in %) [Range 0 to 100]

Creates a window around the average flow measurement reading defining the limits in which the automatic damping increases will occur. If the rate varies within the hysteresis window, greater damping will occur up to the maximum values set by the flow filter Damping entry. The filter also establishes a flow rate window where measurements outside of the window are captured by the Bad Data (Rejection) Window. The value is entered as a percentage of actual flow rate.

For example a Hysteresis setting of 5% allows the flow to vary ± 5% from the currently established flow rate without automatically decreasing the value of the Damping.

Example:

If the average flow rate is 100 GPM and the Hysteresis is set to 10%, a filter window of 90-110 GPM is established. Successive flow measurements that reside within that window are recorded and averaged in accordance with the Damping setting. Flow readings outside of the window are rejected or accepted in accordance with the Bad Data Rejection setting.

Filter settings for example:

Filter Method	Adaptive
Damping	40 seconds
Sensitivity	60%
Hysteresis	10%
Bad Data Rejection	3

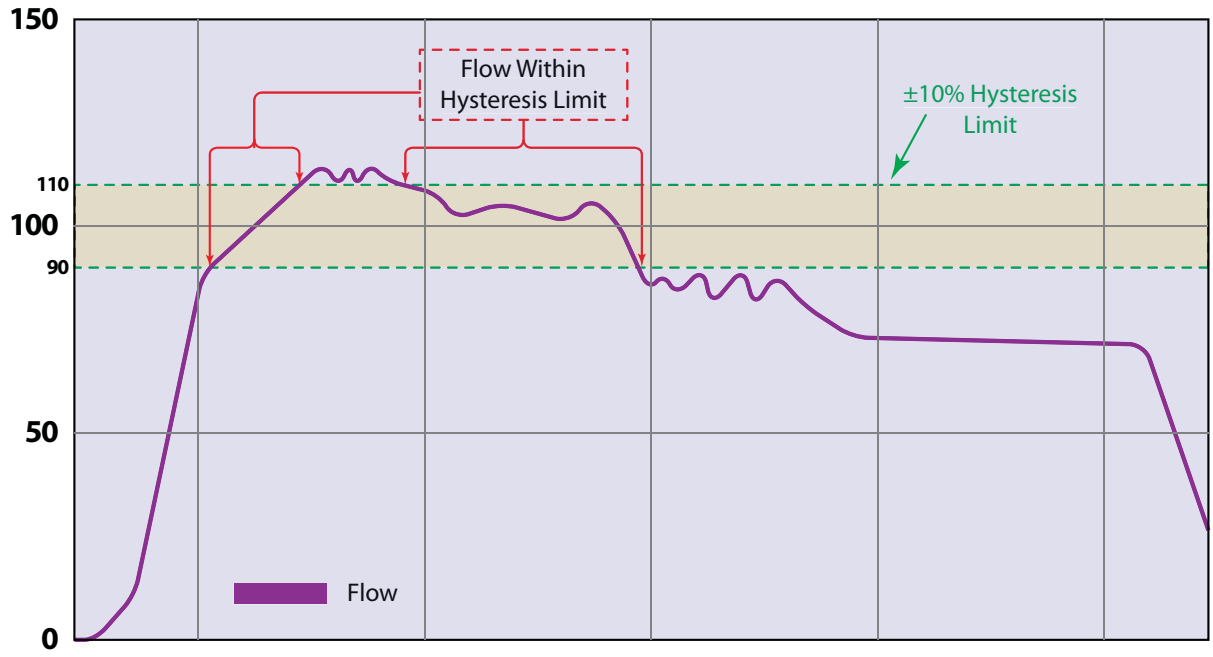


FIGURE 4.33 - HYSTERESIS WINDOW

Bad Data Rejection - (Number of Samples) [Range 0 to 10 Samples]

Bad Data Rejection is a value related to the number of successive readings that must be measured outside of a the hysteresis value before the flow meter will consider the new flow value valid. In the example a hysteresis setting of 10% would produce a ± 10% band centered on the current valid flow rate of 100 GPM.

The Bad Data Rejection setting is the number of successive samples that must be outside of the Hysteresis Window before the flow meter will consider the change in flow is real. Larger values are entered into the Bad Data Rejection window when measuring liquids that contain gas bubbles, as the gas bubbles tend to disturb the ultrasonic signals and cause more extraneous flow readings to occur. Larger Bad Data Rejection values tend to make the flow meter less responsive to rapid changes in actual flow rate.

In ***Figure 4.34*** flow data falls outside the flow hysteresis window but does not reach the minimum time specified in the bad data window. When data appears that is outside the hysteresis band and shorter than the bad data window time the data is rejected.

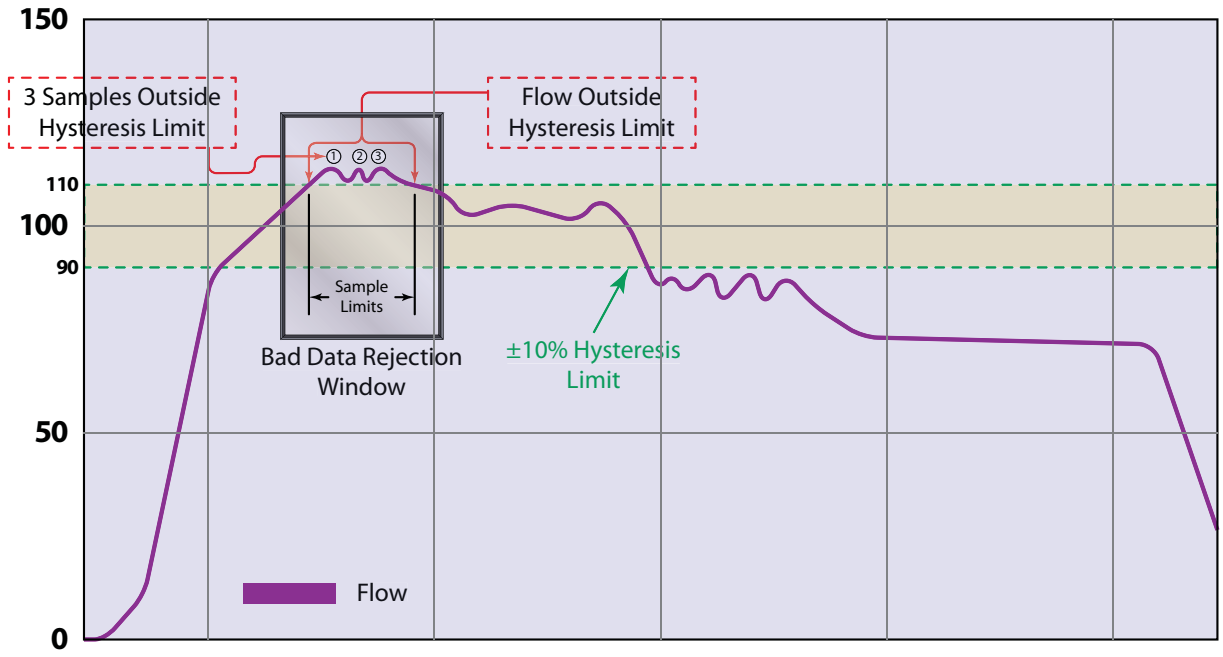


FIGURE 4.34- BAD DATA (REJECTION)

Figure 4.35 shows the flow rate is again outside the original ±10% hysteresis window but the data exists for a time period greater than the Bad Data Window. In this instance the meter interprets the data as a new valid flow rate and moves the hysteresis window to correspond with the new established flow rate.

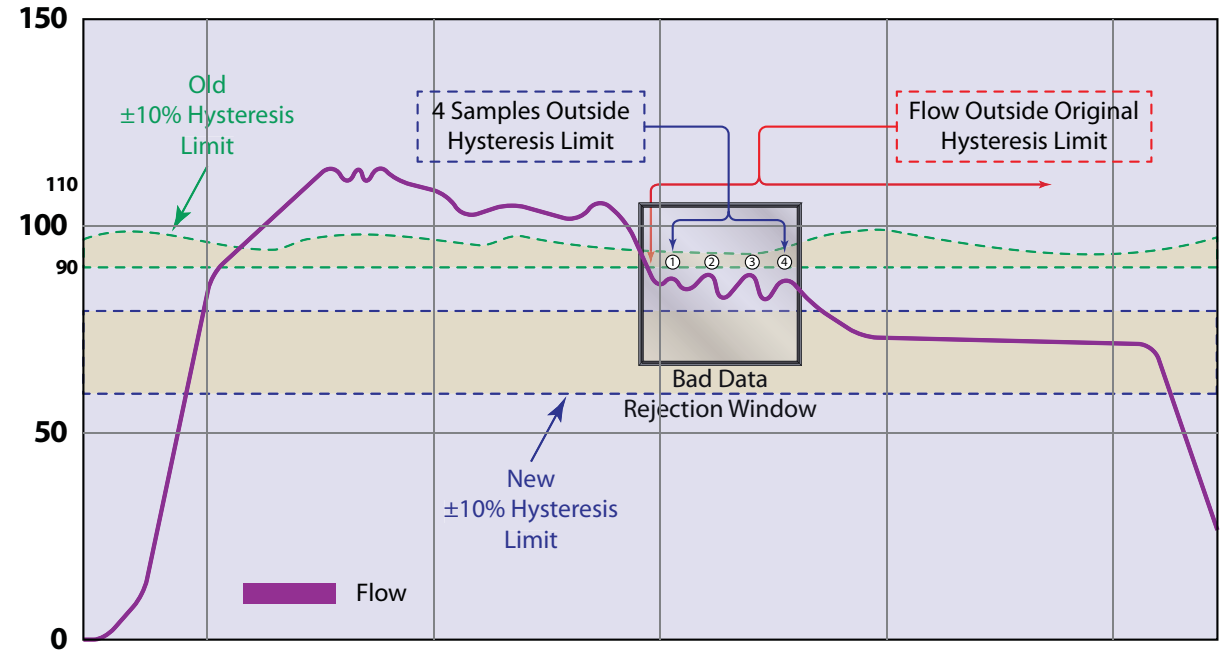


FIGURE 4.35 - NEW VALID FLOW DATA

Energy Page

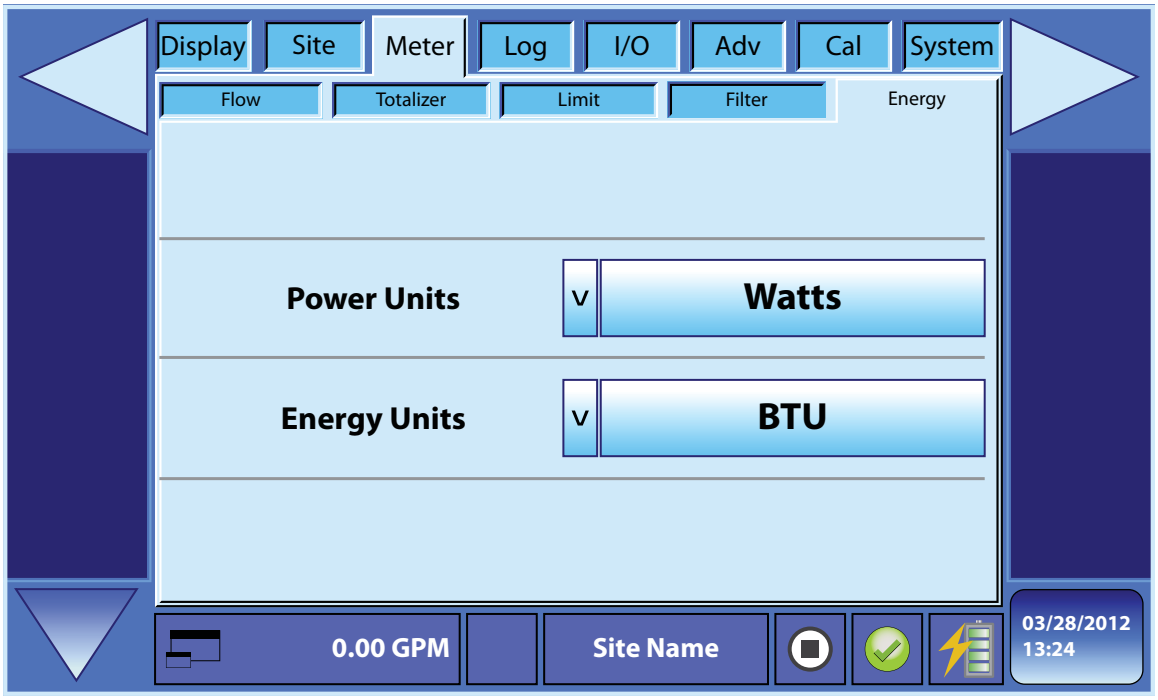


FIGURE 4.36 - ENERGY UNITS SELECTION

Watts	BTU per hour (BTU/hr)	Thousand Joules per hour (kJ/hr)
Kilowatts (kW)	Thousand BTU per hour (MBTU/hr)	Million Joules per hour (MJ/hr)
Megawatts (MW)	Million BTU per hour (MMBTU/hr)	

TABLE 4.10 - POWER UNIT CHOICES

British Thermal Units (BTU)	Ton (s)	Thousand Watt Hours (kWh)
Thousands of BTUs (MBTU)	Thousand Joules (kJ)	
Millions of BTUs (MMBTU)	Million Joules (MJ)	

TABLE 4.11 - ENERGY UNIT CHOICES

DATA LOGGING (LOG) GROUP

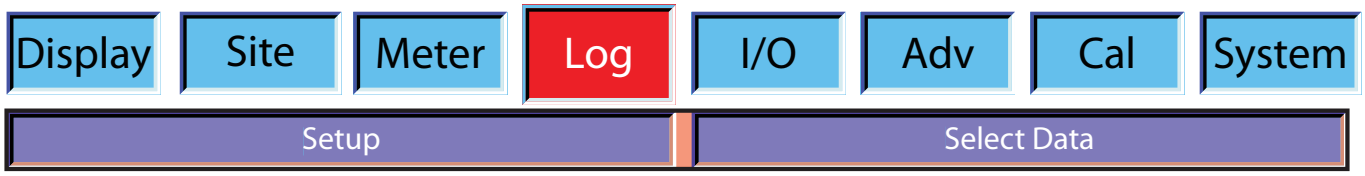


FIGURE 4.37 - LOG GROUP

Setup

The setup screen controls the selection of the **Logging Rate** and has a software button for starting and stopping logging sessions.

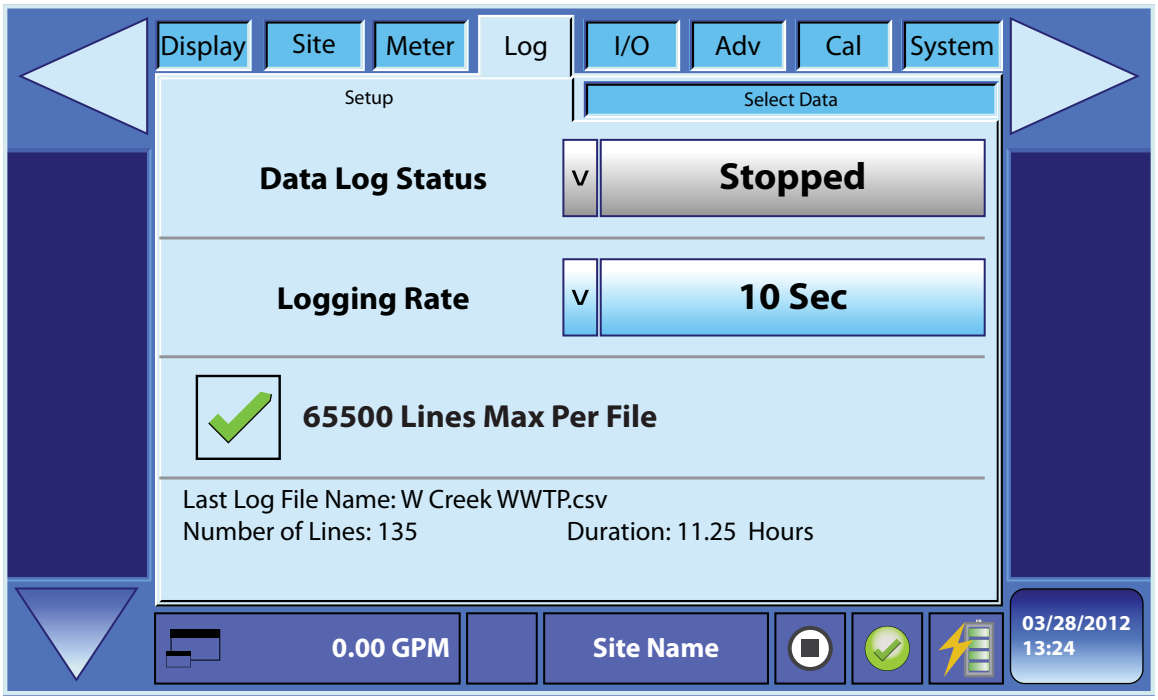


FIGURE 4.38 - DATALOGGING SETUP

Important: To enable datalogging a site from the **Site Group ► Create Page** must be either created or selected from previous site names. If a site is not chosen the datalogger start/stop control button will not function and the control will be "grayed out".

The logging rate entry tells the DXN how often to collect data points. The logger memory area has the capacity to store more than 300 individual files consisting of a maximum of 65,500 points per log file.

The amount of time the logger will collect data depends on the **Logging Rate** the DXN is programmed for. In general the logging time is calculated by dividing 65,563 by the number of data points recorded per minute.

$$\text{Logging Time (Minutes)} = \frac{65{,}563}{\text{Number of Samples per Minute}}$$

LOGGING RATE (ONCE EVERY #)	LOGGING DURATION			
	SAMPLES/SECOND	MINUTES	HOURS	DAYS
0.1 SEC (10 HZ)	10	109	1.8	0.08
1 SEC	1	1092	18.2	0.76
2 SEC	0.5	2183	36.4	1.52
5 SEC	0.2	5458	91.0	3.79
10 SEC	0.1	10917	182	7.58
20 SEC	0.05	21833	364	15.2
30 SEC	0.03333	32750	546	22.7
1 MIN	0.01667	65500	1092	45.5
2 MIN	0.008333	131000	2183	91.0
5 MIN	0.003333	327500	5458	227
10 MIN	0.001667	655000	10917	455
30 MIN	0.00055556	1965000	32750	1365
1 HOUR	0.00027778	3930000	65500	2729
2 HOURS	0.00013889	7860000	131000	5458
4 HOURS	6.941^{-5}	15720000	262000	10917
12 HOURS	2.315^{-5}	47160000	786000	32750
1 DAY	1.157^{-5}	94320000	1572000	65500

TABLE 4.11 - LOGGING DURATIONS

Any log files gathered are stored with the site information.

Select Data

The **Log Group ► Select Data Page** allows the user to choose the way the time is displayed for each logged entry and what kind of data is recorded in the user fields.

FIGURE 4.39 - DATA SELECTION (PAGE 1)

The time column can be set up for three different time stamp formats.

1) The conventional Year, Month, Day, Hour, Minute, and seconds.
2) The Microsoft Excel® decimal time format.
3) A simple counter that increments once for each logged entry recorded.

The second column always stores the current flow rate in the user selected units.

There are also three user defined fields that can be configured to capture any of the following values.

Nothing	Flow	Totalizer Net
Flow Velocity	Reynolds Number	Power
Energy Net	TT Flow	TT Gain
TT Quality	DOP Flow	DOP Gain
DOP Quality	TT Delta T	TT Raw Delta T
TT Fluid SOS	DOP Flow Velocity	DOP Frequency
TT Aperture Start	RTD 1 Temperature	RTD 2 Temperature
RTD Delta Temperature	I/O Voltage In	

TABLE 4.12 - LOGGING PARAMETER CHOICES

FIGURE 4.40 - DATA SELECTION (PAGE 2)

INPUT / OUTPUT (I/O) GROUP

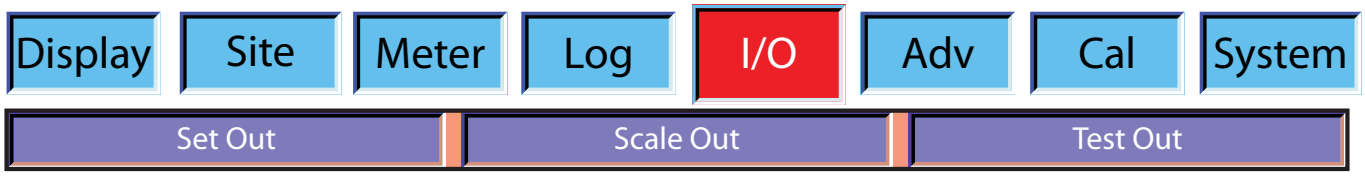


FIGURE 4.41 - I/O GROUP

Setup Outputs (Set Out)

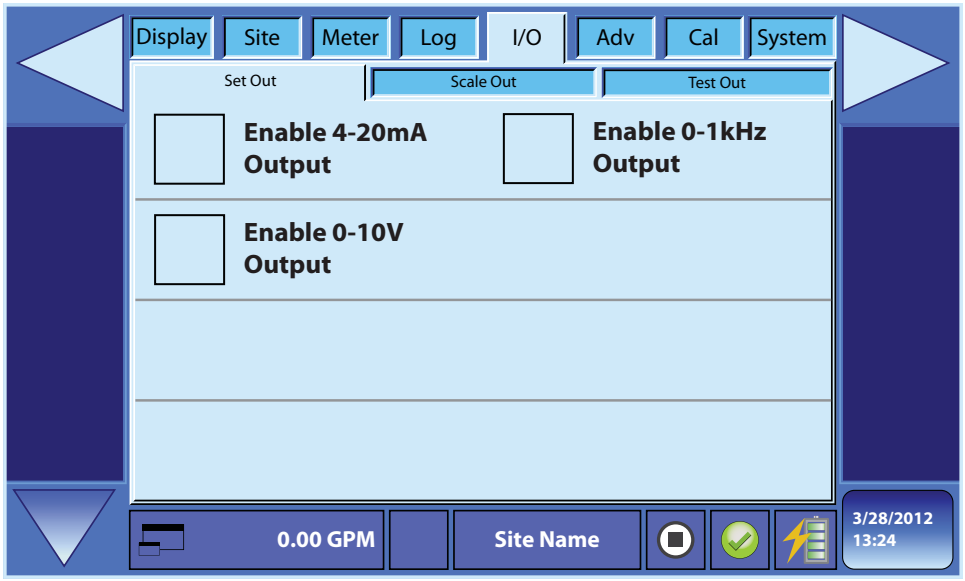


FIGURE 4.42 - DATA OUTPUTS SETUP

The **I/O Group ► Set Out Page** controls which of the DXN outputs are active. The DXN output signals can be described as analog, or digital/pulse. Analog signals change continuously over time, digital/pulse signals are present at discrete points and represent information using a sequence of on/off pulses. For connection information see ***Section 5***.

The type of I/O available from the DXN is set using check boxes. The two analog outputs are 4-20 mA and either a 0-5 VDC or a 0-10 VDC output. The pulse output has a maximum frequency of 1,000 Hz and can be configured as either a rate pulse or a totalizing pulse.

NOTE: *The 0-5 V and 0-10 V outputs are mutually exclusive and can not both be selected at the same time.*

Whichever output is used all outputs are scaled the same way using the **I/O Group ► Scale Out Page.** In other words 20 mA, 1,000 Hz, and either 0-5 V or 0-10 V will all represent the same Maximum flow rate set in the **I/O Group ► Scale Out Page**

Scale Outputs (Scale Out)

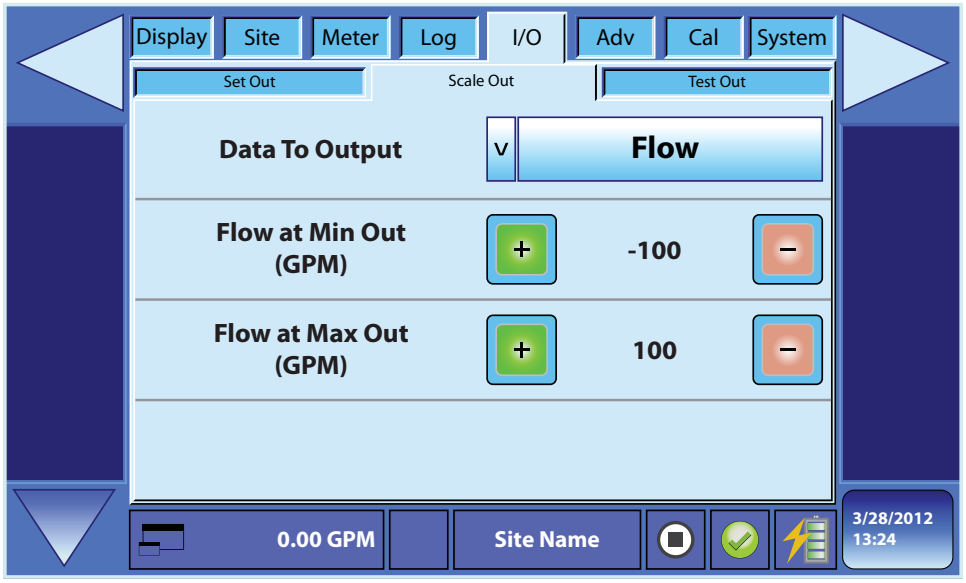


FIGURE 4.43 - SCALE OUTPUTS SETUP

The **I/O Group ► Scale Out Page** sets the parameter the output circuitery will respond to. Choices for "**Data To Output"** are either **Flow** or **Power**. Additionally this screen sets the minimum and maximum values the outputs will be scaled to.

NOTE: *Transit time measurements are capable of bidirectional flow but Doppler is not. The only time setting the "***Flow at Min Out***" to a negative value may be necessary is if the meter stays in transit time mode. If the meter is used in Doppler mode exclusively or when in hybrid mode the meter switches to Doppler mode the value for "***Flow at Min Out***" should be set no lower than zero.*

An example of a valid use of setting "**Flow at Min Out**" below zero would be a transit time application where flow can be in either the forward or reverse direction. If for instance a tap water system is capable of 100 GPM forward and 100 GPM in reverse then setting the "**Flow at Min Out**" to -100 and "**Flow at Max Out"** to +100 would be valid entries.

If the meter were programed to output a 4-20 mA signal than 4 mA would represent -100 GPM and 20 mA would indicate +100 GPM. The zero flow point would be indicated as 12 mA (half way between 4 mA and 20 mA).

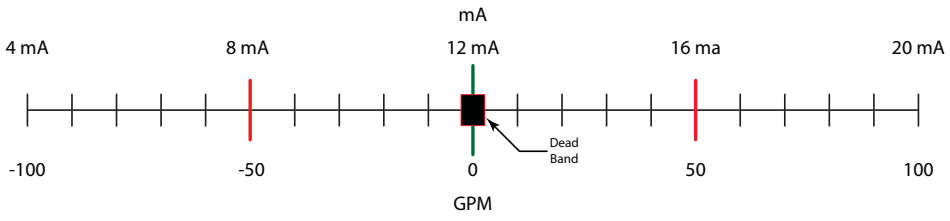


FIGURE 4.44 - BIDIRECTIONAL CURRENT OUTPUT

Also keep in mind that no flow meter can read down to zero. There is going to be a small "dead band" around true zero where the velocity of the fluid is not great enough for the meter to register. The absolute minimum under perfect conditions is 0.1 fps (0.03 mps). Whatever flow rates these velocities correspond to will be the minimum dead band around true zero.

Test Outputs (Test Out)

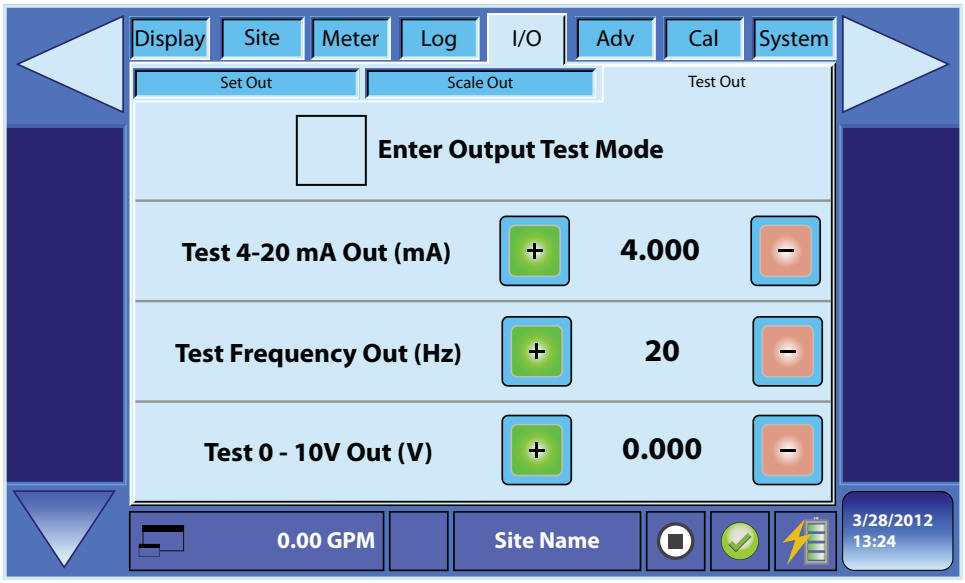


FIGURE 4.45 - TEST OUTPUTS SETUP

Test Out is used to calibrate devices connected to the DXN thru the I/O breakout box. To use this function first connect the desired output to a device designed to read that type of output signal. For 4-20 mA out use a milliammeter. For the 0-10 VDC output use a voltmeter and for the frequency output either a frequency counter or oscilloscope is necessary.

Next using the + and − buttons select the output level to calibrate to. For example common test levels for the 4-20 mA output are 4, 8, 12, 16, and 20 mA.

Finally put a check mark in the "**Enter Output Test Mode**" box to activate the outputs

ADVANCED (ADV) GROUP

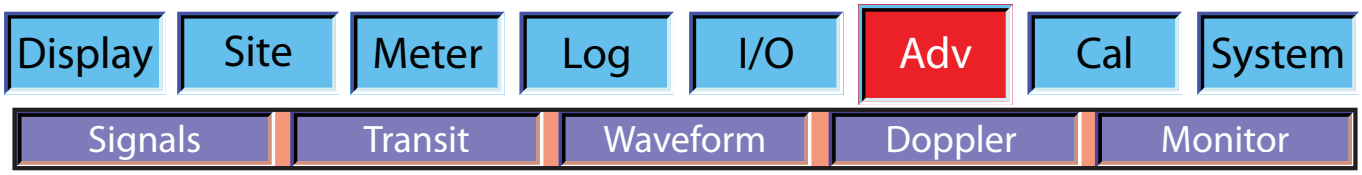


FIGURE 4.48 - ADVANCED GROUP

Signals

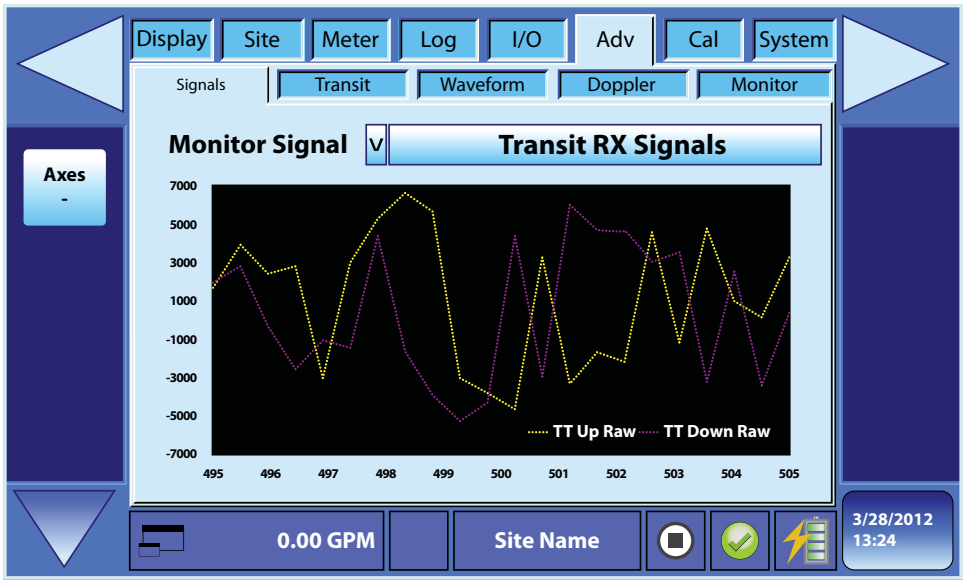


FIGURE 4.49 - ADVANCED SIGNAL SELECTION

Select the signal type to be monitored and adjust the graph scale using the Axes adjustments.

Transit RX Signals	Transit RX Signals Analyzed	Transit RX Noise
Transit RX Xcor	Transit RX Xcor Alt	Transit RX Envelope
Transit RX Alt	Transit TX Waveout	Doppler Best Acorr
Doppler Best Rate	Doppler Full Rate	Doppler HI Rate
Doppler MED Rate	Doppler LO Rate	

TABLE 4.13 - WAVEFORM CHOICES FOR GRAPHING

Axes Scaling Buttons

Control of the axis scaling is performed with the axes scaling buttons. Pressing the **Axes** button successively will move through the three axis configuration choices as shown in ***Figure 4.50***.

The X axis is always time based. Use the or buttons to either expand or contract the time line shown on the horizontal (X axis). The minimum graph time period is 10 seconds and the maximum is 1 year.

The Axes Y Lt and Axes Y Rt functions control the scale of the left hand and right hand sides of the graph respectively.

The and buttons work in the same fashion as on the X axis except for on the Y Lt and Y Rt axis they are used to expand or contract the range of the vertical scaling.

The and arrow buttons are used to shift the zero point of the graph up or down.

Pressing the Home button resets the graph to the parameters set using the **Graph Group ► Setup Page** screen.

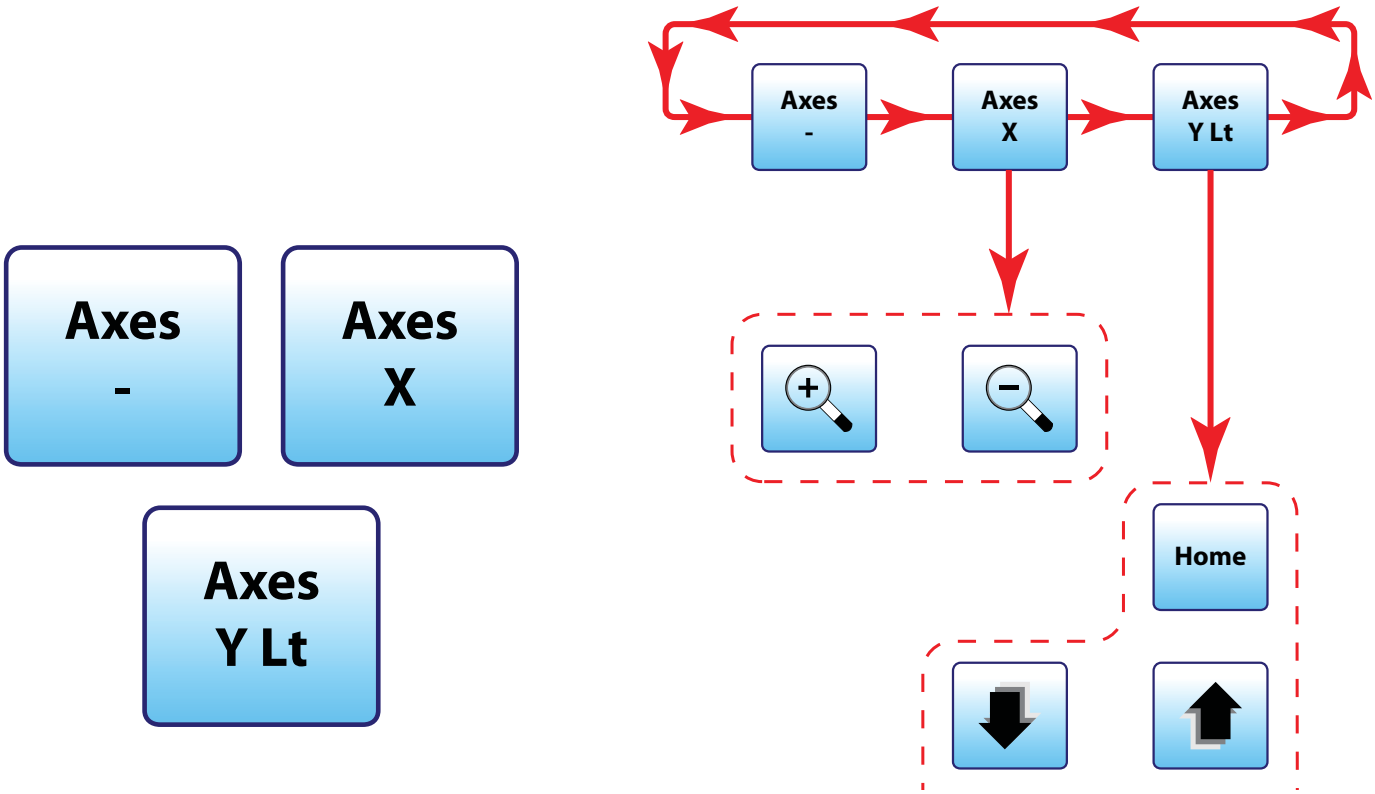


FIGURE 4.50 - GRAPH AXIS CONFIGURATION

Transit

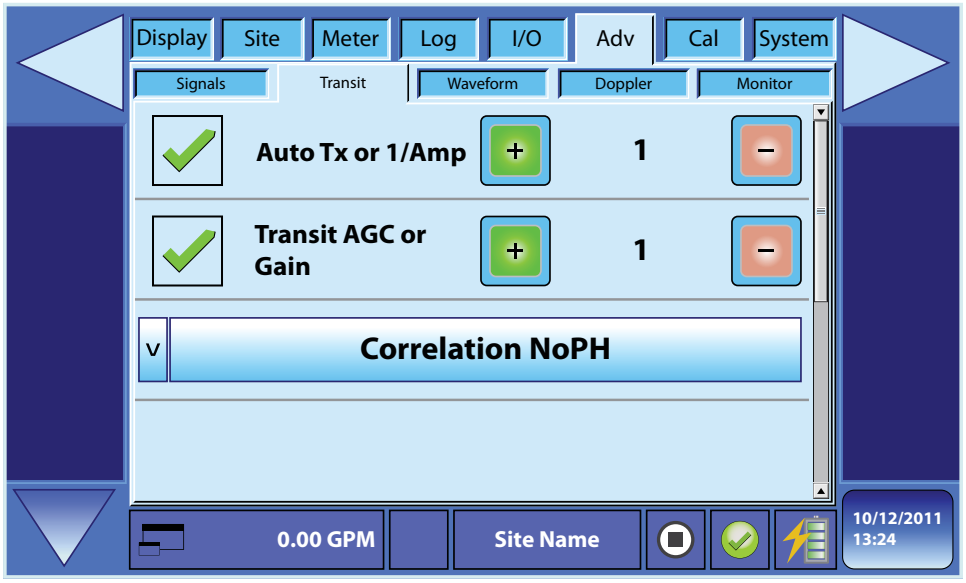


FIGURE 4.51- ADVANCED TRANSIT TIME SETUP

Waveform

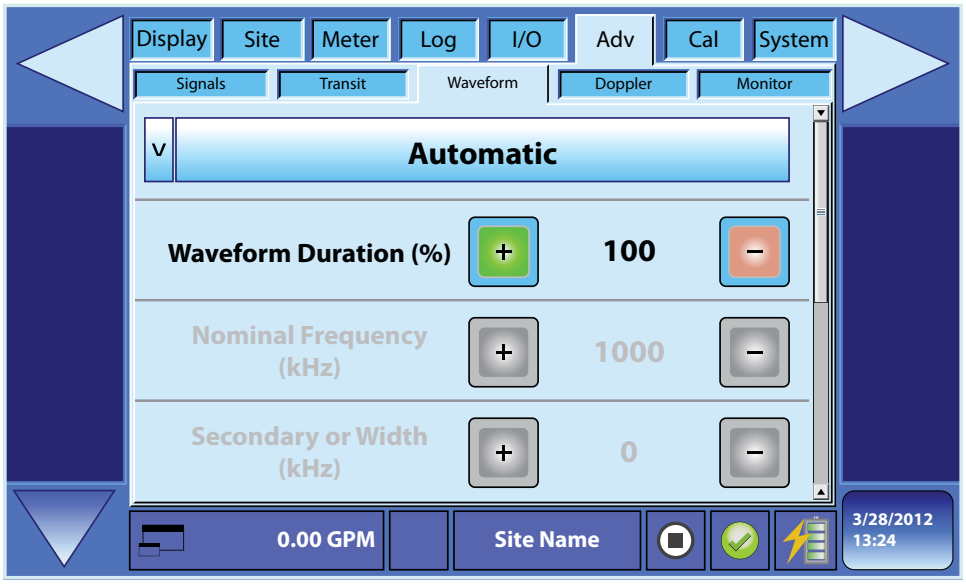


FIGURE 4.52- ADVANCED WAVEFORM SELECTION

For almost all applications the "**Automatic**" waveform selection should be selected. In some very special circumstances an alternate waveform may be selected at the direction of Dynasonics technical department.

Automatic	Sin	Sin Carrot Top
Sin Sin	Sin Sin Carrot Top	Sin AM Sin
Sin AM Sin Carrot Top	Chirp	Chirp Carrot Top
Best Barker	Best Barker Square	Sin Alt
Sin Carrot Top Alt		

TABLE 4.14 - WAVEFORM CHOICES

Doppler

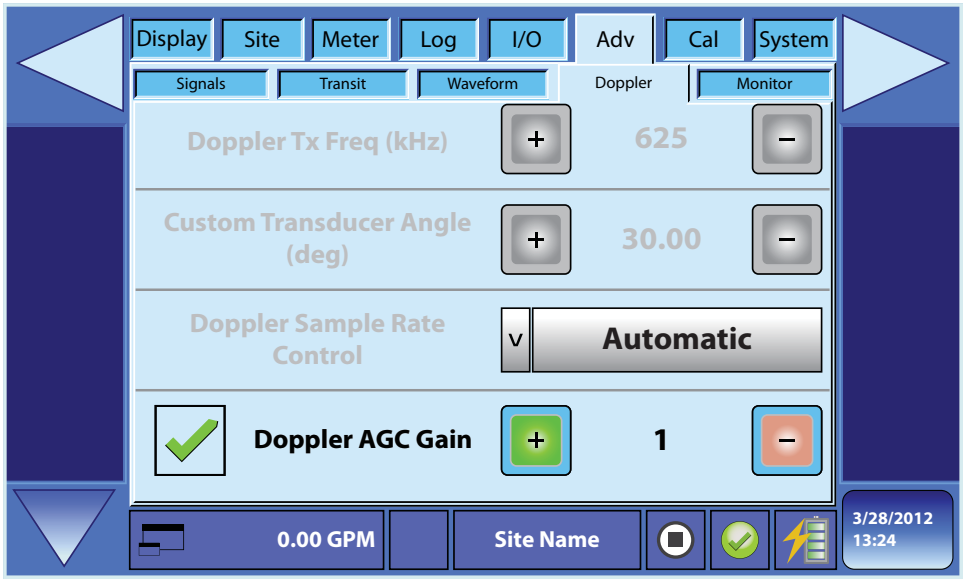


FIGURE 4.53 - ADVANCED DOPPLER SETUP

Monitor

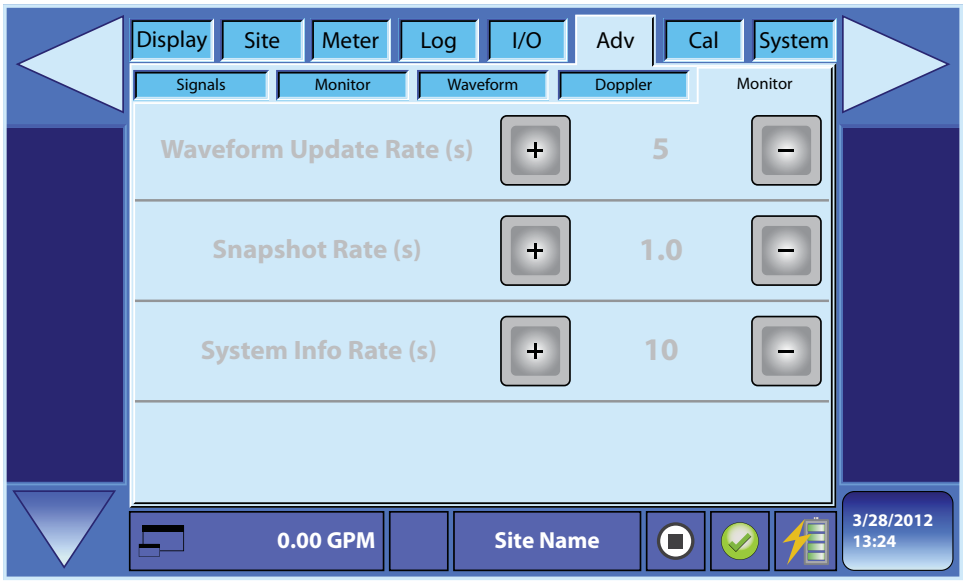


FIGURE 4.54 - ADVANCED MONITOR

CALIBRATION (CAL) GROUP

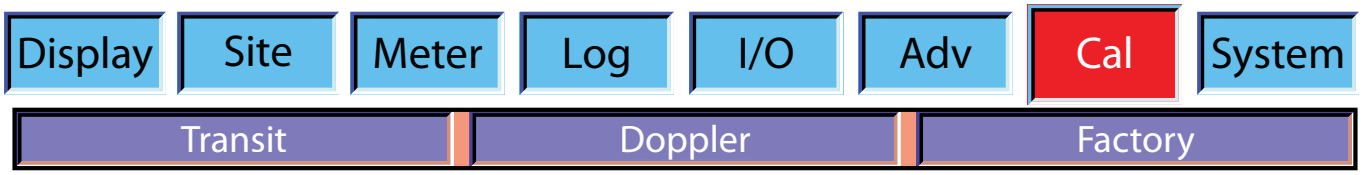


FIGURE 4.55 - ADVANCED GROUP

Transit

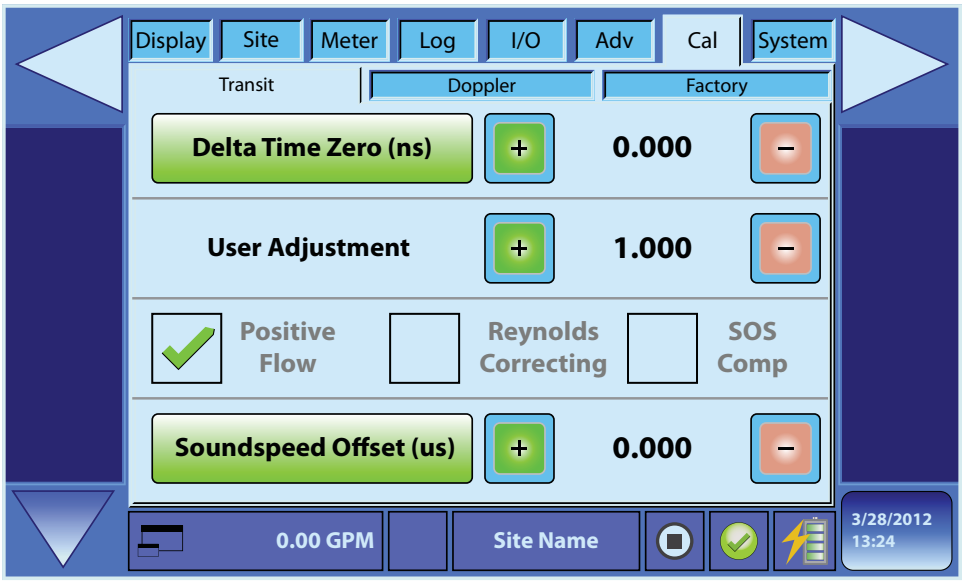


FIGURE 4.56 - CALIBRATE TRANSIT TIME

The Delta Time Zero (ns) zeros (removes the "No Flow" transit time offset) when pressed. This is also referred to as "Zeroing" the meter.

Because every flow meter installation is slightly different and sound waves can travel in slightly different ways through these various installations, it is important to remove the zero offset at zero flow to maintain the meter's accuracy. A provision is made using this button to establish "Zero" flow and eliminate the offset.

Procedure:

1) The pipe must be full of liquid.
2) Flow must be absolutely zero - securely close any valves and allow time for any settling to occur.
3) Press the Transit Time Zero button (Delta Time Zero) once

Doppler

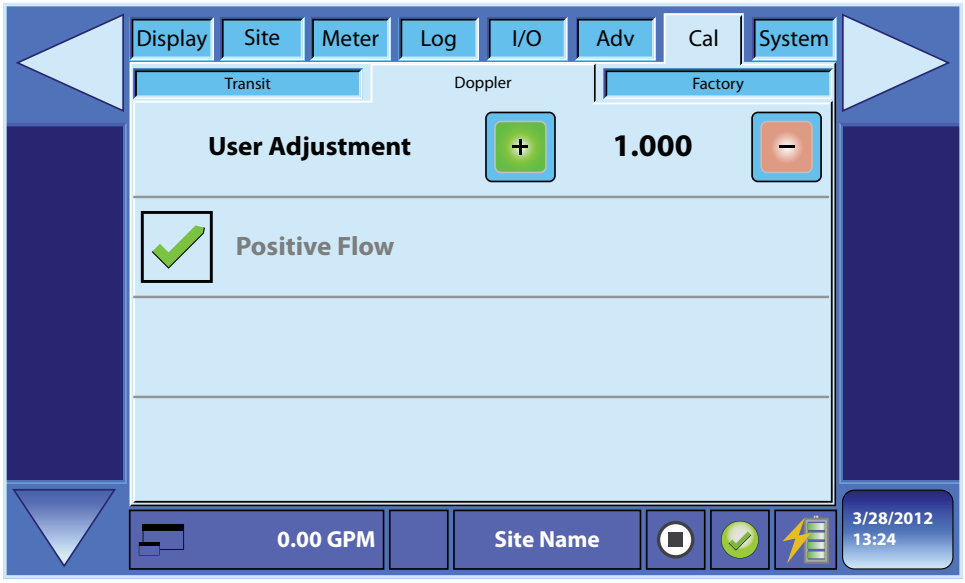


FIGURE 4.57 - CALIBRATE DOPPLER

Factory

The factory calibration screen shows all the parameters stored in the DXN's memory originally derived during calibration. These are the values that will be re-loaded if the "**Load Default Settings**" from the **Site Group ► Create Page** is used.

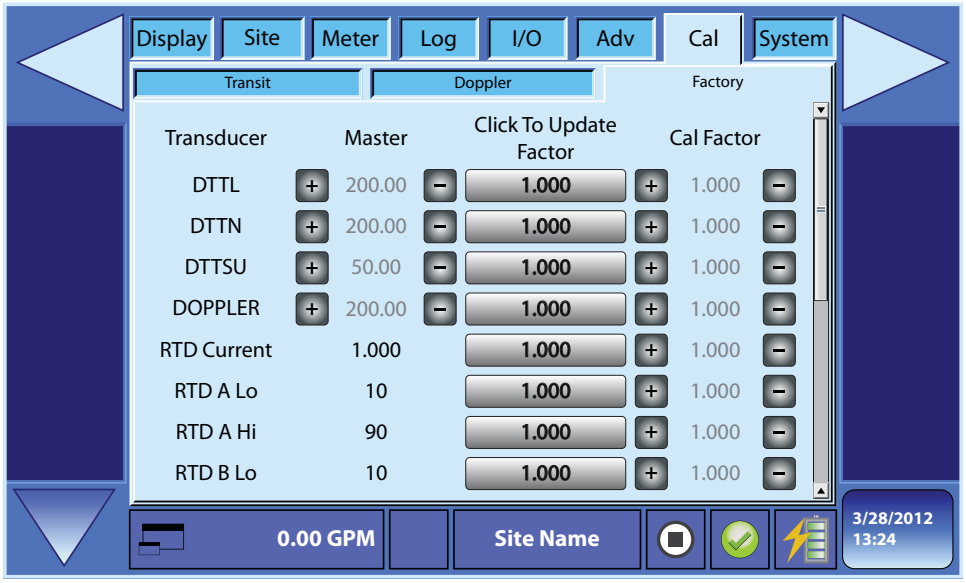


FIGURE 4.58 - FACTORY CALIBRATION (PAGE 1)

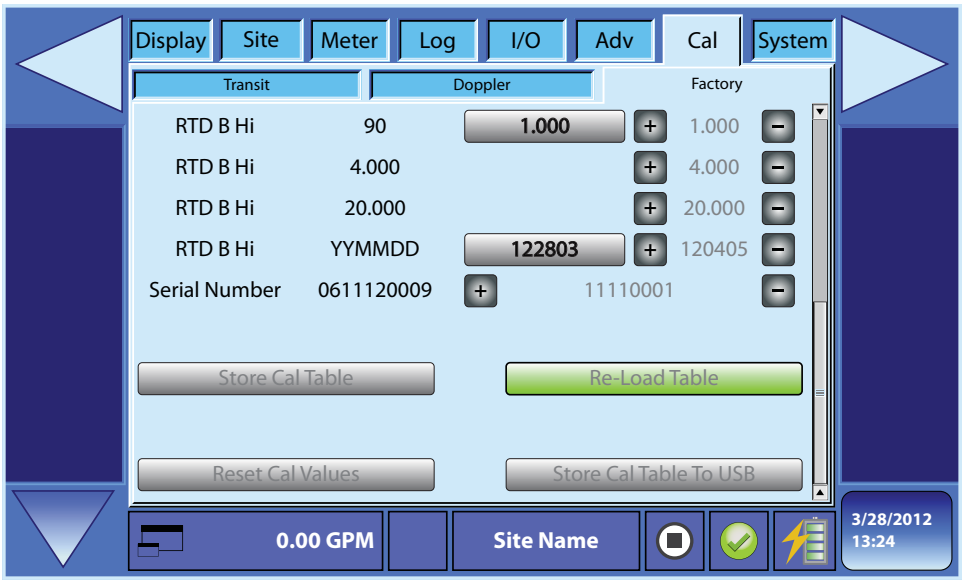


FIGURE 4.59 - FACTORY CALIBRATION (PAGE 2)

SYSTEM GROUP

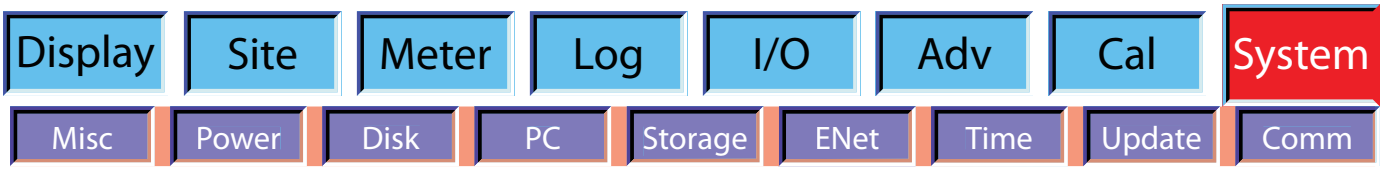


FIGURE 4.60 - SYSTEM GROUP

Miscellaneous

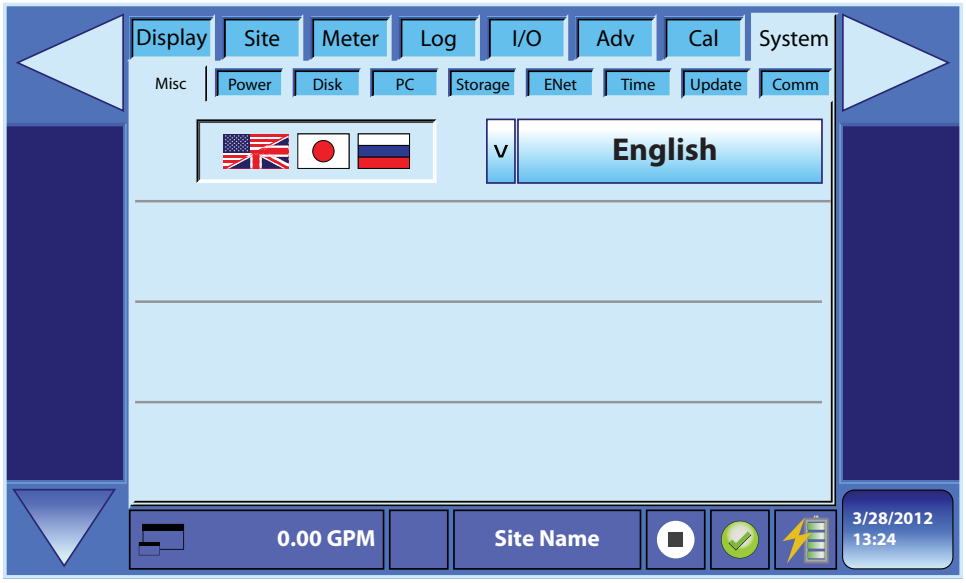


FIGURE 4.61 - SYSTEM MISCELLANEOUS

Language

The "**Language**" button allows the user to select the language the screens are displayed in. Select the required language by pressing one of the flag buttons or from the dropdown menu followed by pressing the Set button.

Power

The **System Group ► Power Page** is a group of indicators reporting on the state of the internal Lithium-Ion battery.

The DXN has a sophisticated battery management circuit that ensures a long trouble-free battery life. The meter can remain connected to the charger without fear of "over-charging" the battery.

The page consists of four indicating lights and a graph showing % charge and battery temperature. The first two lights are battery status lights and the last two indicate if the charger is connected and how many charging cycles the batter has been through.

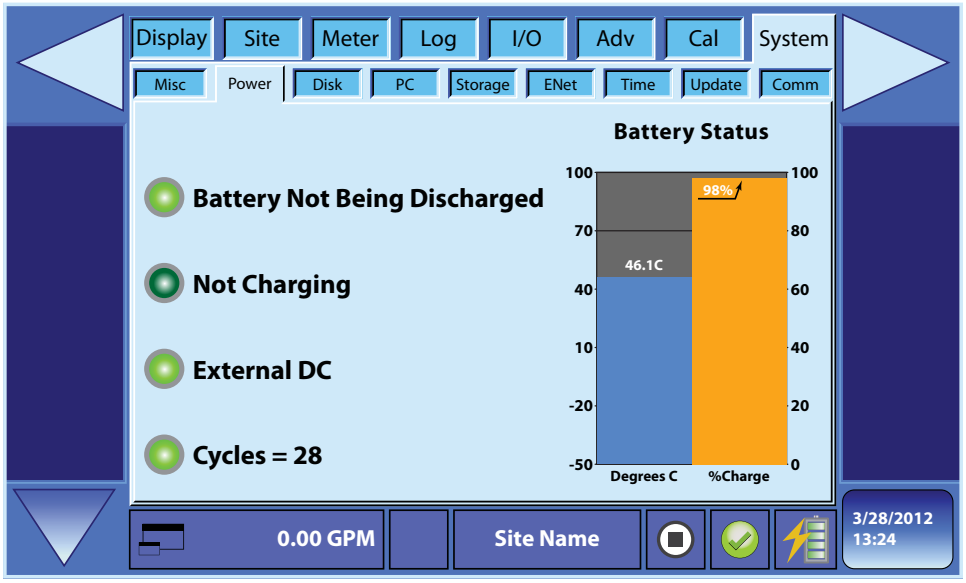


FIGURE 4.62 - SYSTEM POWER

The first light stays lit as long as there is enough power remaining in the batter to run the meter. When the meter is connected to the battery charger the text to the right of the light will say "**Battery Not Being Discharged**". When the charger is removed the text will change to show the estimated running time before the battery becomes fully discharged. A typical status message would be "**6.5 Hours Battery Runtime**".

The battery life indicator is continuously being updated so if the current draw from the battery increases such as the outputs being switched on the runtime indicator will recalculate the battery life.

The second light reports on the battery's charging status. It will say either "**Charging**" or "**Not Charging**" The battery will only charge when there is a need and the charger is connected. The fact that the charger is connected doesn't necessarily mean that the battery will be charging.

The third light indicates whether the charger is connected. When the "**External DC**" light is on the charger is connected and powering the meter. The charger may or may not also be charging the battery depending on the battery status.

The fourth and final light is the "Cycle" counter and indicate the number of charging cycles the battery had undergone.

The graphs to the right of the battery status indicator show the present temperature of the battery and the percentage of charge the battery currently holds.

Disk

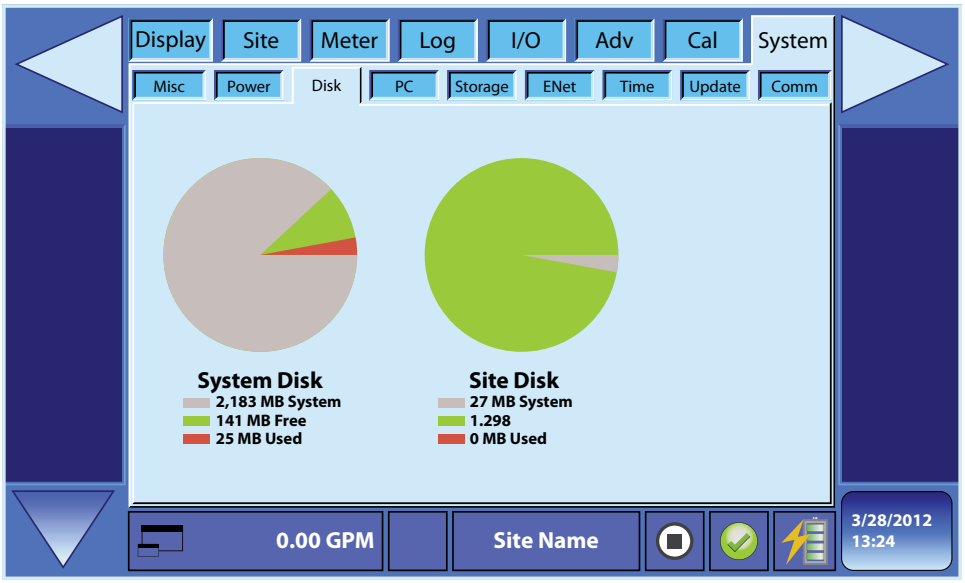


FIGURE 4.63 - SYSTEM DISK

The **System Group ► Disk Page** provides information about the meters hard disk storage capacity. The DXN utilizes an 8 gigabyte hard drive of which 1 gigabyte is available to the user.

PC

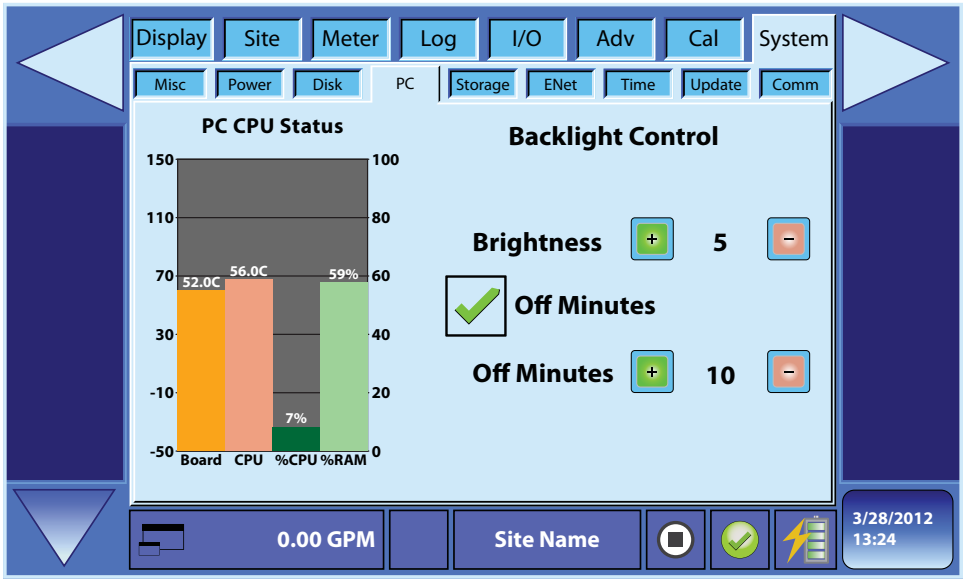


FIGURE 4.64 - SYSTEM PC

The **System Group ► PC Page** contains the backlight brightness control and the switch for the automatic screen saver. Judicious use of these controls will help extend the battery life between charging's. The WVGA screen used in the DXN consumes about ⅓ of the battery capacity when the meter is running on battery. By using the screen saver and lowering the amount of backlight when conditions permit can significantly extend the battery life for that particular session.

The backlight "**Brightness**" control ranges from a low of 1 (least bright) to 5 (most bright).

The screens saver has a range of 0 to 50 minutes.

If the meter is running with the battery charger connected there is no need to either decrease the backlight or use the screen saver function.

The second portion of the operations is populated by a graph showing the temperature of the system processor board and the CPU (**C**entral **P**rocessing **U**nit). Also shown are the percentages of RAM (**R**andom **A**ccess **M**emory) used and how busy the CPU is.

Storage

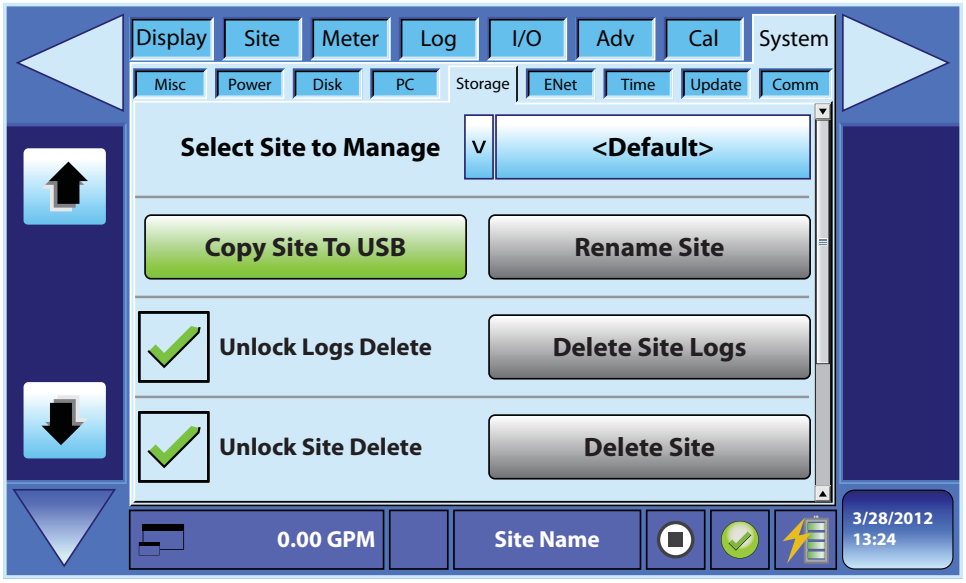


FIGURE 4.65 - SYSTEM STORAGE

The selections in the **System Group ► Storage Page** allows the management of sites stored in the DXN memory.

First for any site to be worked on it must be selected. Use the "**Select Site to Manage**" to choose the site to be modified or deleted. Once the site is selected several actions become available.

Copy Site To USB

Copies all of the files associated with the selected site to a USB device connected to the USB port on the meter

Rename Site

As its name implies allows the site name to be changed.

Delete Site Logs

To delete the site logs it is first necessary to "**Unlock Logs Delete**" by placing a check mark in the "**Unlock Logs Delete**" box. When that is accomplished the "**Delete Site Logs**" button will change to red and pressing this button will delete all the logs for the site chosen in the "**Select Site To Manage**" control.

Delete Site

The "**Delete Site**" control is similar to the "**Delete Site Logs**" except it deletes both the site logs and the site itself. As with the "**Delete Site Logs**" a check mark must be placed in the "**Unlock Site Delete**" to activate the "**Delete Site**" button. When activated the button will turn red warning that the entire site is about to be deleted. Once pressed the site and the site logs will be deleted from the DXN memory space.

ENet

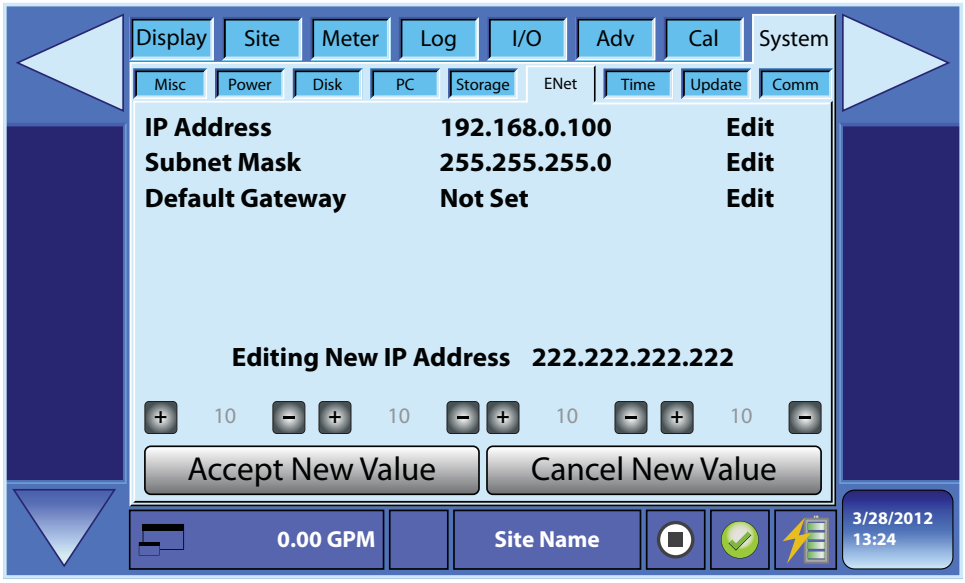


FIGURE 4.66 - SYSTEM ETHERNET (ENET)

Time

The **System Group ► Time Page** provides date and time setting controls. The current date is conveniently shown on a calendar page with the currently programed date highlighted in blue. The DXN also allows the time to be displayed in either a 12 or 24 hour format.

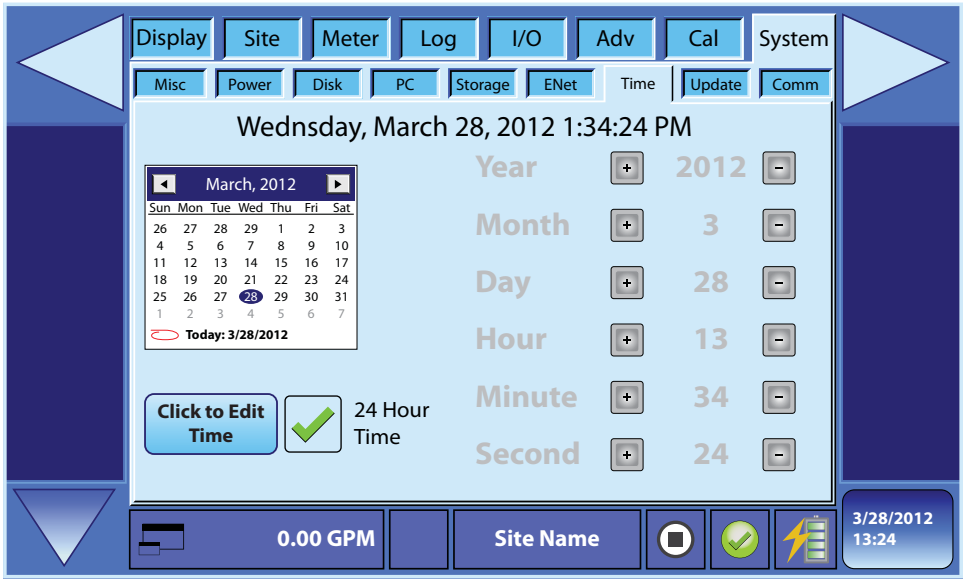


FIGURE 4.67 - SYSTEM TIME

To access the date/time controls click the button that says "**Click to Edit Time**". When this button is pressed all the date/time controls on the right hand side of the screen will become active and the button will now say "**Click to Set Time**".

Next using the + and − buttons set the correct date and time. When the date/time parameters have been set up press the "**Click to Set Time**" button to load the settings into the DXN's memory.

Update

The **System Group ► Update Page** is used in conjunction with software updates supplied by Dynasonics to install new software revisions into the DXN. For complete updating instructions see "Upgrading Software" in the Appendix of this manual.

FIGURE 4.68 - SYSTEM UPDATE

Communications (Comm)

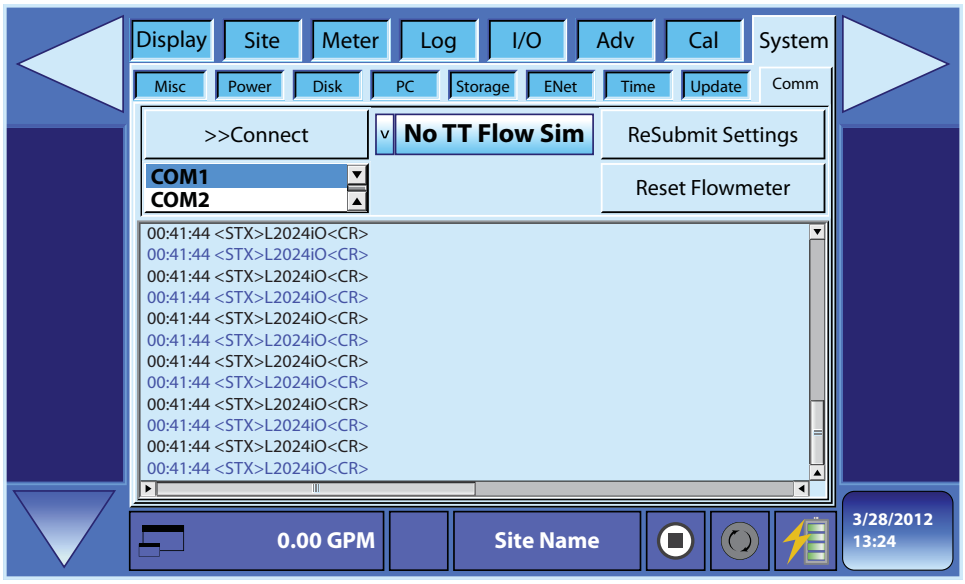


FIGURE 4.69 - SYSTEM COMMUNICATIONS (COMM)

5 - INPUTS/OUTPUTS

GENERAL

The DXN is comes with a variety of input / output options. The individual I/O connections are accessed by using the included “Breakout Box” connected to the DXN via a DB15 cable connection. This connection is labled “Process I/O”

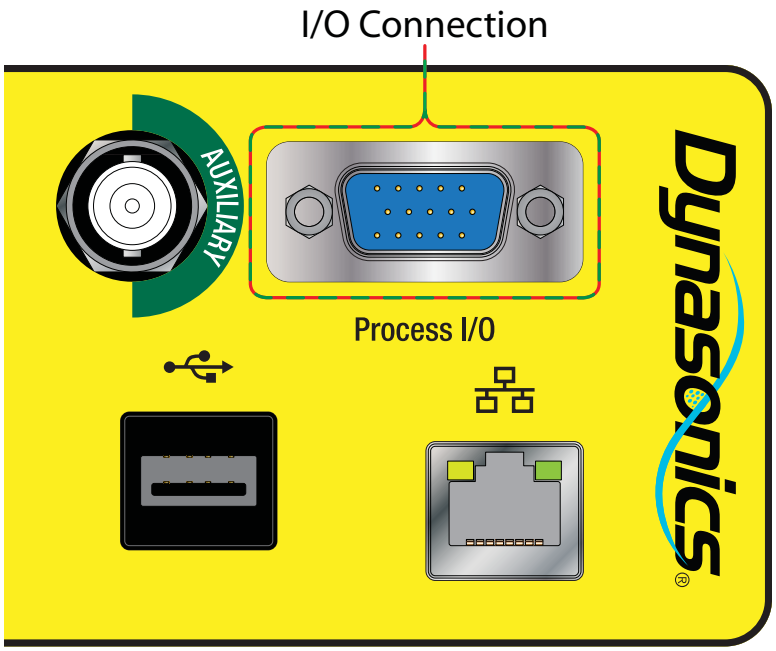


FIGURE 5.1 - DISPLAY I/O CONNECTION

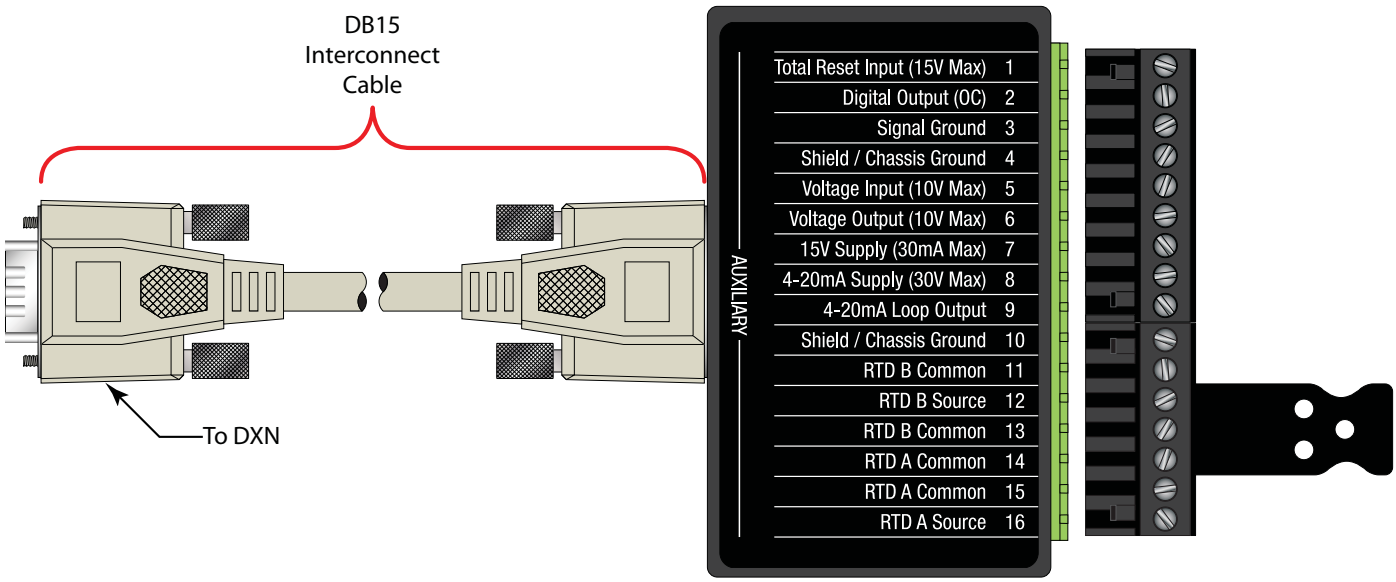
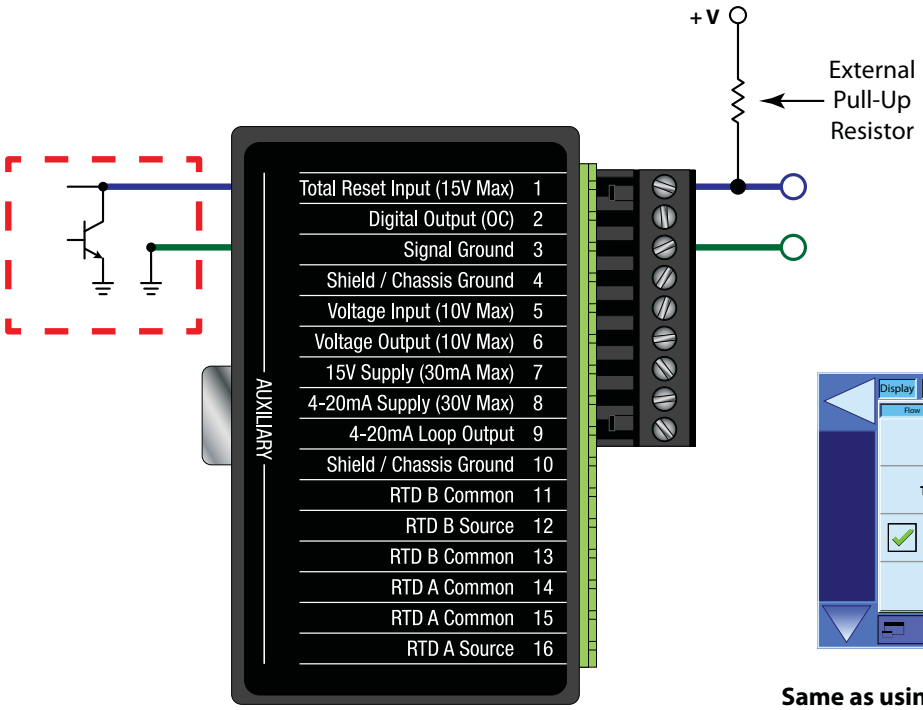
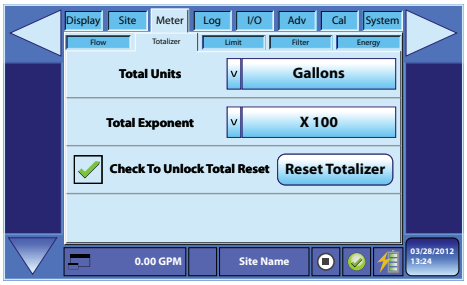


FIGURE 5.2 - BREAKOUT BOX

Total Reset





Same as using Meter ► Totalizer Reset Totalizer

FIGURE 5.3 - EXTERNAL TOTALIZER RESET

DIGITAL OUTPUTS

Digital/Pulse Outputs

The digital output is an open collector transistor which must have a pull-up resistor to function. The output can be configured as either a frequency output scaled based upon the minimum and maximum flow rate chosen or a totalizing pulse controlled by the incrementing totalizer.

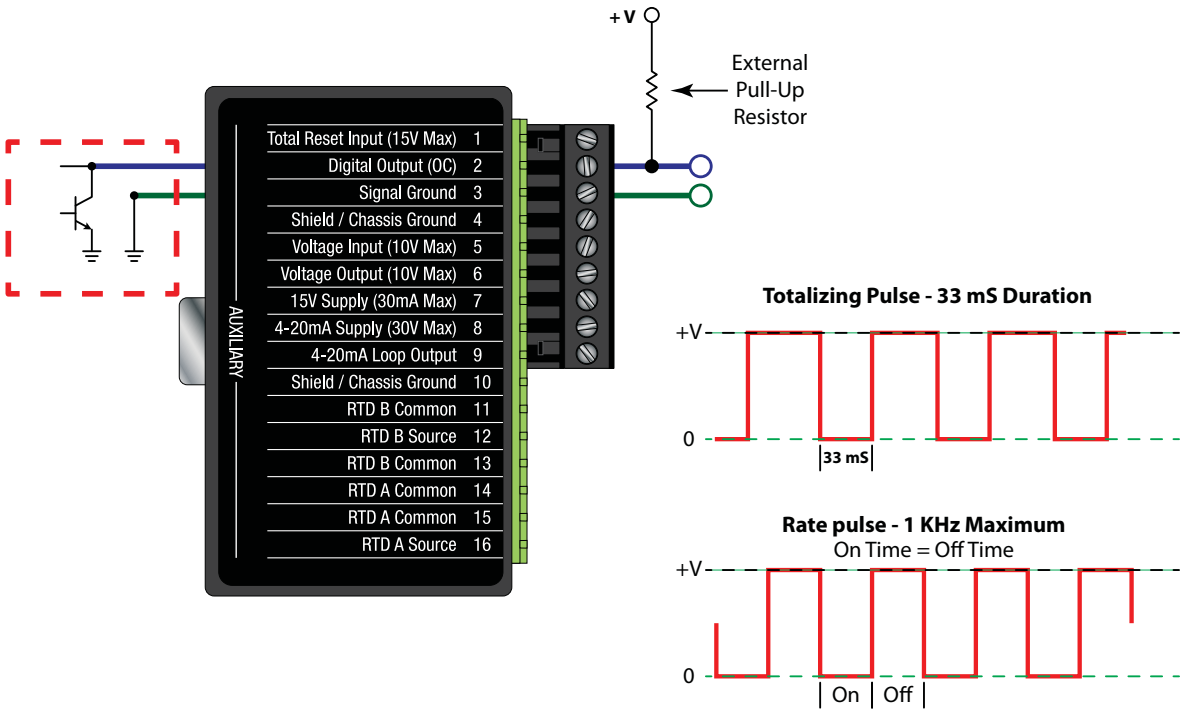


FIGURE 5.4 - DIGITAL OUTPUT EXTERNAL POWER

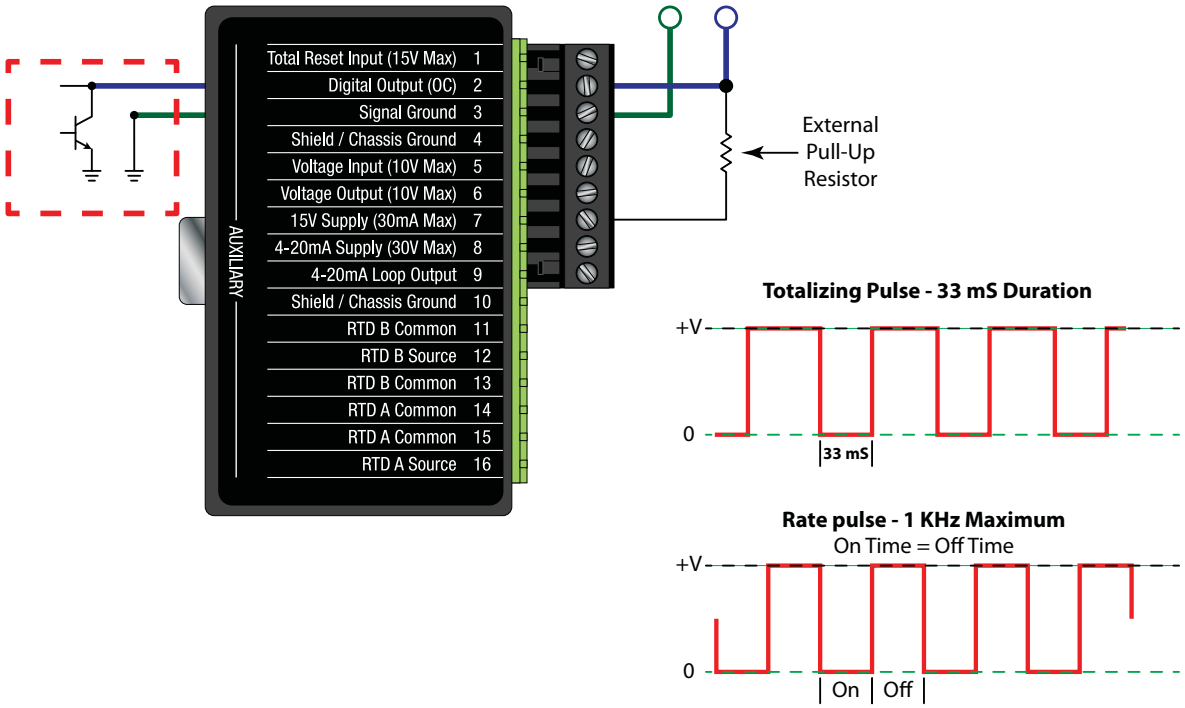


FIGURE 5.5 - DIGITAL OUTPUT INTERNAL POWER

Rate Pulse Scaling

The rate pulse has a maximum frequency of 1,000 Hz which is proportional to the minimum and maximum user flow rates entered. Setting the minimum and maximum flow rates is accomplished using the **Meter Group ► Limit Page** software controls.

For example if the minimum flow rate were set to -100 GPM and the maximum flow rate was +100 GPM the 1,000 Hz output would span the distance between -100 GPM and +100 GPM.

In this example the output frequency would then be interpreted as follows:

0 Hz	=	-100 GPM
250 Hz	=	-50 GPM
500 Hz	=	0 GPM
750 Hz	=	+50 GPM
1,000 Hz	=	+100 GPM

The maximum current capacity for the transistor is 100 mA with a maximum supply voltage of 10 VDC. These parameters require the pull-up resistor to at least a **minimum of 1,000 ohms**.

In rate pulse output mode the transistor has a duty cycle of 50%

Totalizing Pulse

When used to transmit a totalizing pulse the digital output sends a fixed width (33 mS) pulse that follows the display totalizer. For each increment of the totalizer the digital output will send 1 pulse. The duration of the pulse will be 33 mS with an amplitude approximately equal to the level of +V. See **Meter Group ► Totalizer Page** to set totalizer parameters.

NOTE: *The totalizing pulse output is for positive going flow only. Under reverse flow conditions the totalizer will neither increment or decrement.*

ANALOG OUTPUTS

Analog outputs are signals that changes continuously over time. In most control applications, analog signals range continuously over a specified current or voltage. The DXN offers a DC voltage output and two styles of 4-20 mA current output. See **I/O Group ► Set Out Page**

Voltage Output (10 VDC Max)

The voltage output can be configured as either 0-5 VDC or 0-10 VDC. Analog signals represent continuously variable measurements.

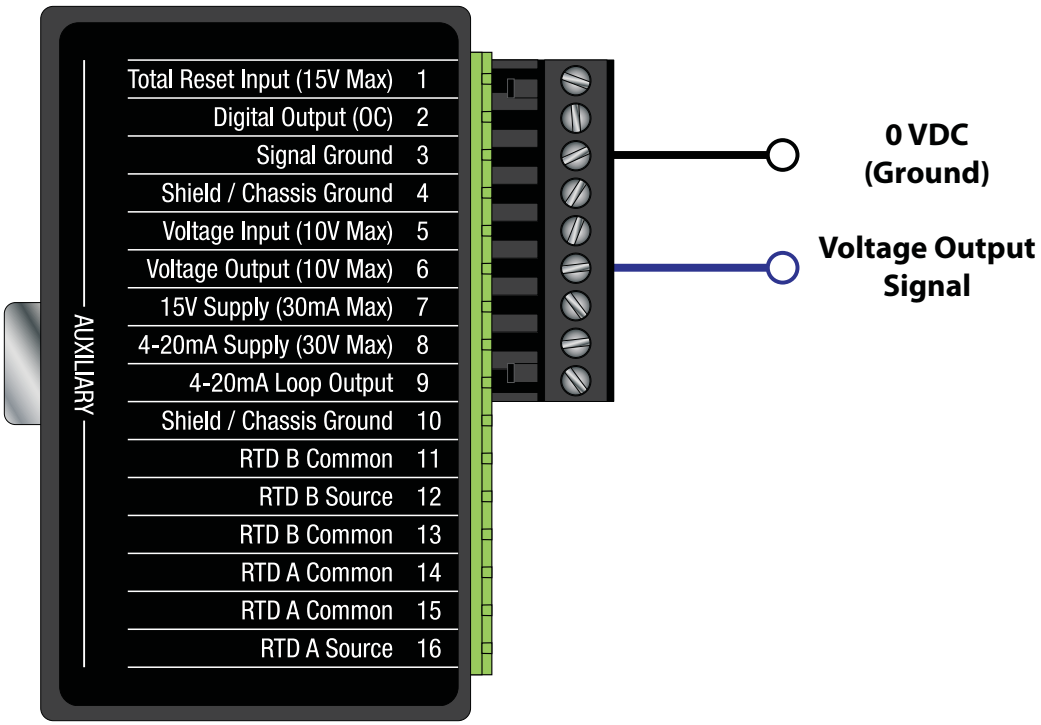


FIGURE 5.6 - VOLTAGE OUTPUT CONNECTION

4-20 mA Current Loop Output (Current Sinking)

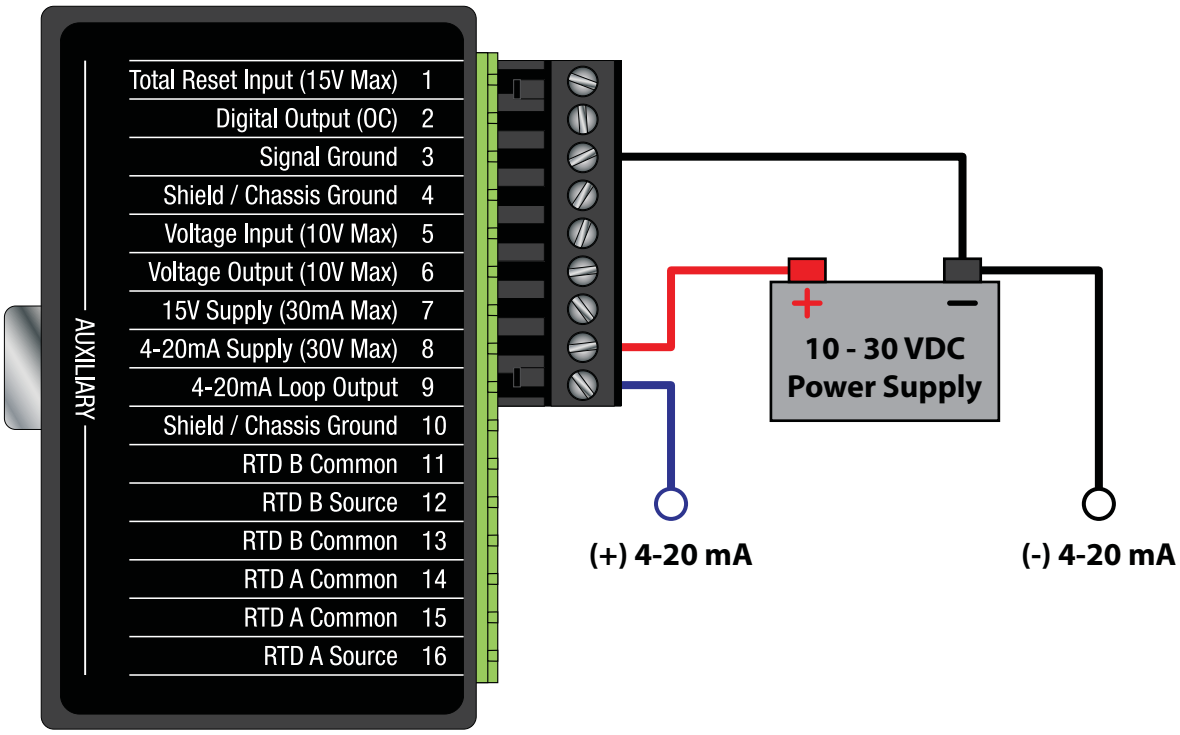


FIGURE 5.7 - 4-20 mA CURRENT SINKING OUTPUT

The 4-20 mA output interfaces with most recording and logging systems by transmitting an analog current signal that is proportional to system flow rate. The 4-20 mA output is internally powered (current sourcing) and can span negative to positive flow/energy rates.

The 4-20 mA output is driven from a +15 VDC source located within the meter. The source is isolated from earth ground connections within the DXN. The 4-20 mA output signal is available between the 4-20 mA Out and Signal Ground terminals as shown in ***Figure 5.7***.

4-20 mA Current Output (Current Sourcing)

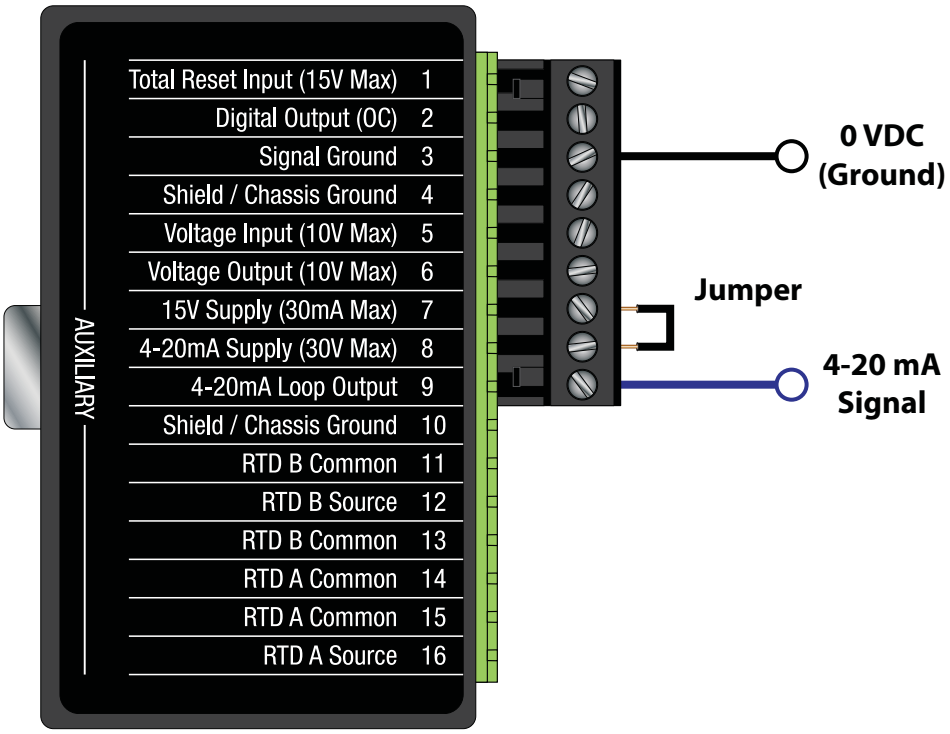


FIGURE 5.8 - 4-20 mA CURRENT SOURCING OUTPUT

The current output from the DXN can also be configured to source current. With terminals 6 and 7 jumpered together the DXN

15 VDC Supply (30 mA Max)

The DXN has a built in power supply that can be used to power current or voltage sensors external to the meter.

4-20 mA Supply (30 VDC Max)

RTD Connections

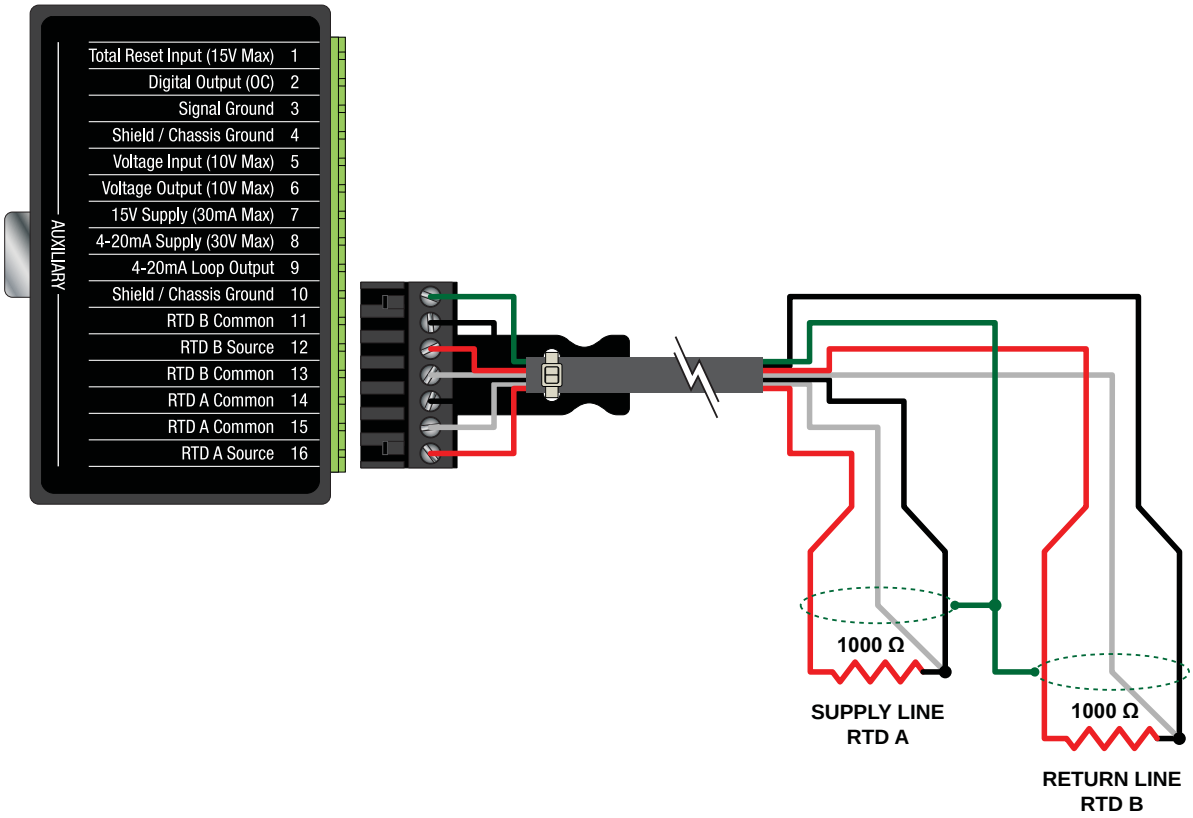


FIGURE 5.10 - RTD CONNECTIONS

APPENDIX

SPECIFICATIONS

System

Measurement Type	**Flow:** **Pipe wall thickness:** **Liquid thermal energy**.	Ultrasonic transit time and Doppler (reflection of acoustic signals); Hybrid operation. Ultrasonic transit time of acoustic signals.
Liquid Types		Liquid dominant fluids
Velocity Range	**Transit Time:** **Doppler:**	Bi-directional to 40 FPS (12 MPS) Unidirectional to 40 FPS (12 MPS)
Flow Rate Accuracy	**Transit Time:** **Doppler:**	±1% of reading or ±0.01 FPS (0.006 MPS), whichever is greater 2% of full scale
Flow Sensitivity		0.001 FPS (0.0003 MPS)
Repeatability		±0.1% of reading
Temperature Accuracy	**Absolute:** **Difference:** **Resolution:**	0.5 °F (1 °C) 0.2 °F (0.5 °C) 0.02 °F (0.01 °C)
Measurement Update		0.1 to 10 seconds update/filter rate. Transit Time, up to 50 Hz high speed mode.
Battery	**Type:** **Charging:**	Internal 11.1 V lithium ion battery, 75 Watt-hour. Provides 6-9 hours of continuous operation with battery and indefinitely on external power. At (0 to 40 °C), 12 hours while in use; 4 hours maximum powered off.
Power Requirements		10-30 VDC via 3-pin connector, 40 W min; 3.6 A resettable fuse
Power Source Types	**Desktop adapter:** **Automotive adapter:**	100-240 VAC 50/60 Hz 50 Watts 12-18 VDC; 5 A fused
AC Power Cords Options	**North American plug:** **China plug:** **Euro plug:** **U.K. plug:** **Japan Plug:**	(2 flat & 1 round prong; NEMA 5/15P) (3 flat prongs; GB2099) (2 round prongs; CEE7/7) (3 rectangular prongs; BS1363A) (2 flat & 1 round, JIS8303, w/ 3-2 prong adapter)
Display		800 × 480 WVGA Color Outdoor Readable Display; Gloved-operation resistive touch screen
Ambient Conditions	**Battery powered:** **Externally powered:**	-4 °F to +110 °F (-20 °C to +45 °C); -20 °F to +140 °F (-30 °C to +60 °C)
Storage Temperature		Do not exceed +175 °F (80 °C)
Enclosure		Water/Dust resistant [IP 64]
User Menu		Windows .NET fully integrated user menu; Multi-language
Internal PC		500 MHz AMD PC, 256 MB RAM, 1GB user storage; Licensed Windows Embedded Standard 2009
Logging		greater than 300 sites stored in 1 GB; downloads to USB jump drive

Transducers		
Pipe Sizes		½" and larger; standard pipe tables built into user Interface
Housing Materials		DTTSU: CPVC, Ultem®, and anodized aluminum track system; Connector: Nickel-plated brass with Teflon® insulation DTTN/DTTL/DT94 Doppler: CPVC, Ultem®; Connector: Nickel-plated brass with Teflon® insulation
Pipe Surface Temperature	**DTTSU/DTTN/DTTL:** **DT94 Doppler:**	-40 ºF to +250 ºF (-40 ºC to +121 ºC) -40 ºF to +212 ºF (-40 ºC to +100 ºC)
Transducer Frequency	DTTSU: DTTN/DTTH: DTTL: DT94 Doppler:	2 MHz, 1 MHz 500 kHz 625 kHz
Cable Lengths	Transit Time: Doppler:	20 feet (6 meters) paired coaxial cable, BNC to BNC, 20 feet (6 meters) paired coaxial cable, BNC to 4-pin
Diagnostics		Open, Short, Nominal (transit time only)
Pipe Thickness		Dual mode transducer with 6 feet (1.8 meters) of cable (BNC ends)
RTD's		2x platinum 385, 1000 Ohm, 3-wire PVC jacketed cable; 20 feet (6 meters) cable standard with quick connector
Process Monitoring Inputs/Outputs		
Connector		15-pin high-density DSUB
Breakout Box		.2" quick disconnect screw terminal; 15 pin to adapter box; 6 feet (1.8 meters) of cable (DSUB to DSUB connectors)
Inputs/Outputs	**Energy/Temperature:**	2x RTDs PT1000 tab type; -122 ºF to +570 ºF (-85 ºC to +300 ºC) measurement range
Current Output		4-20 mA active/passive 1% accuracy
Sensor Supply		4 V @ 50 mA max for powering current or voltage sensors
Digital Output	**Rate or Total pulse user selectable**	Open collector, External pull-up Rate pulse: 0 to 1000 Hz Total pulse: 33 mSec duration
Digital Input		Totalizer reset, External pull-up
Auxiliary Inputs		Voltage input. 0 – 5 V or 0 – 10 V, 1% accuracy Software scaling and control 80k Ohms input impedance
Voltage Output	0 – 5 V or 0 – 10 V output voltage, 1% accuracy Software scaling and control 100 Ohms output impedance	

UPGRADING SOFTWARE

IMPORTANT NOTE: *The Dynasonics USB Flash Drive is formatted in FAT/FAT32. NTFS (New Technology File System) formats will not work.*

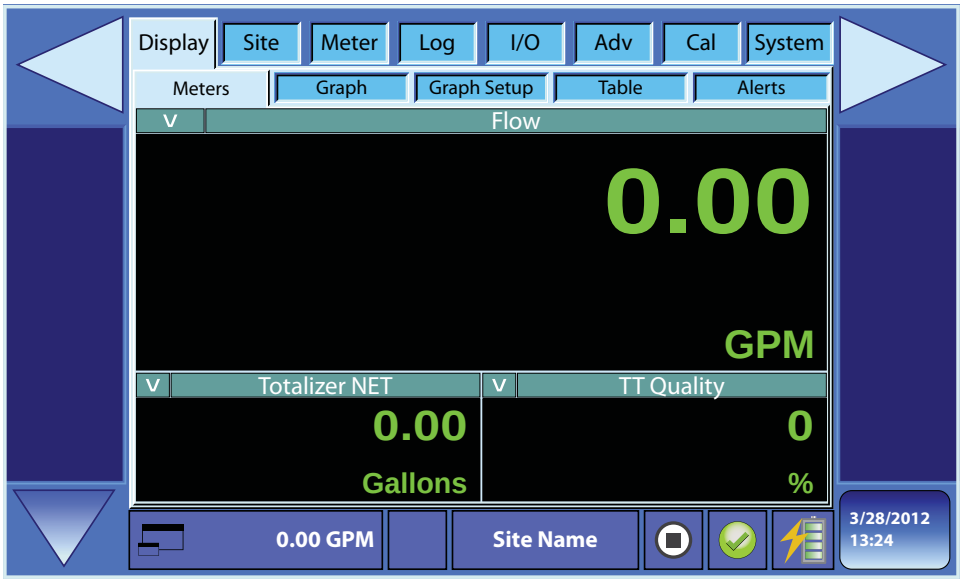
The upgrade is supplied as a self extracting zip file and must be expanded on a PC before it can be loaded into the DXN.

1. Save the supplied zip file to a convenient place on the computers hard drive.
2. Double-click on the ***DXN_Updater_R_x.zip*** file to start the extraction process. The completed extraction should place the folder "PortableFlow meter" on the hard drive. This is the folder that needs to be copied to the USB thumb drive.

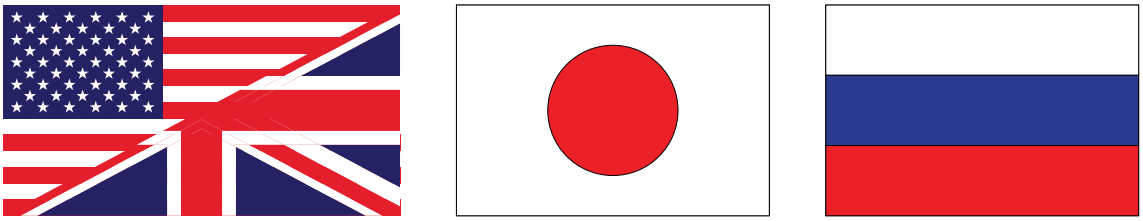
NOTE: *the"x" in the file name stands for the current revision letter.*

Name ▲	Date modified	Type	Size
PortableFlowmeter	11/29/2011 8:11 AM	File Folder	

3. When the extraction process is complete copy the files to a USB thumb drive.
4. Start the DXN and allow it to get to the Display ► Meters screen.



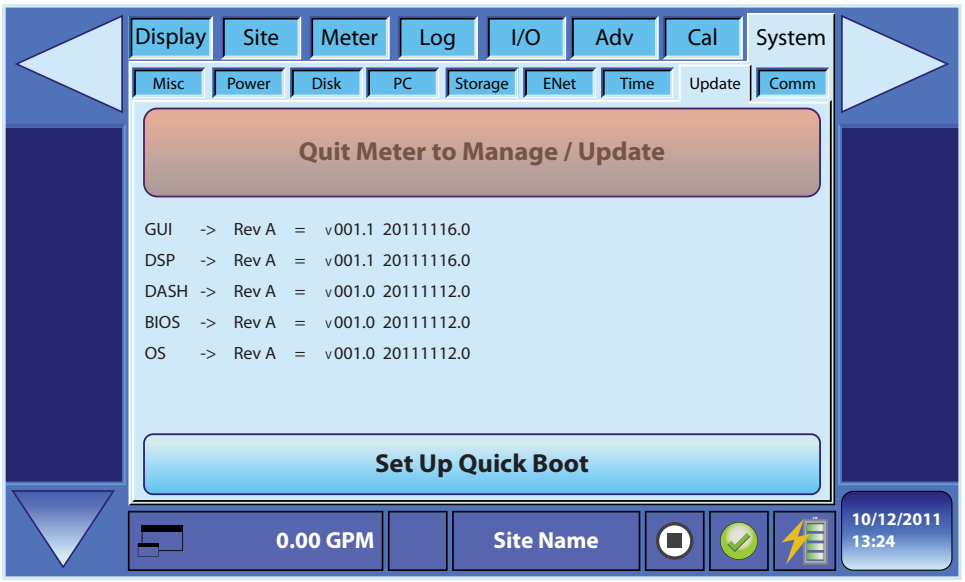
NOTE: *Revision E and later of the DXN firmware has multi-language capabilities. Tabbed information can be shown in Japanese and Russian as well as English. To change the language displayed on the menu tabs push one of the flag icons on one of the update screens.*



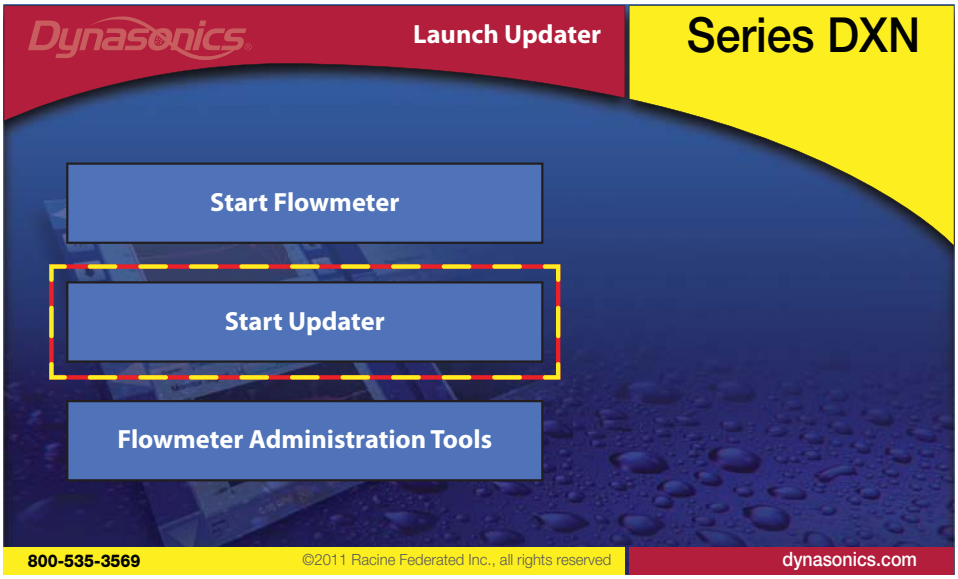
English Japanese Russian

5. Insert the thumb drive into the USB port on the rear of the DXN.
6. From the Display ► Meters screen press the System tab on the far right of the display.

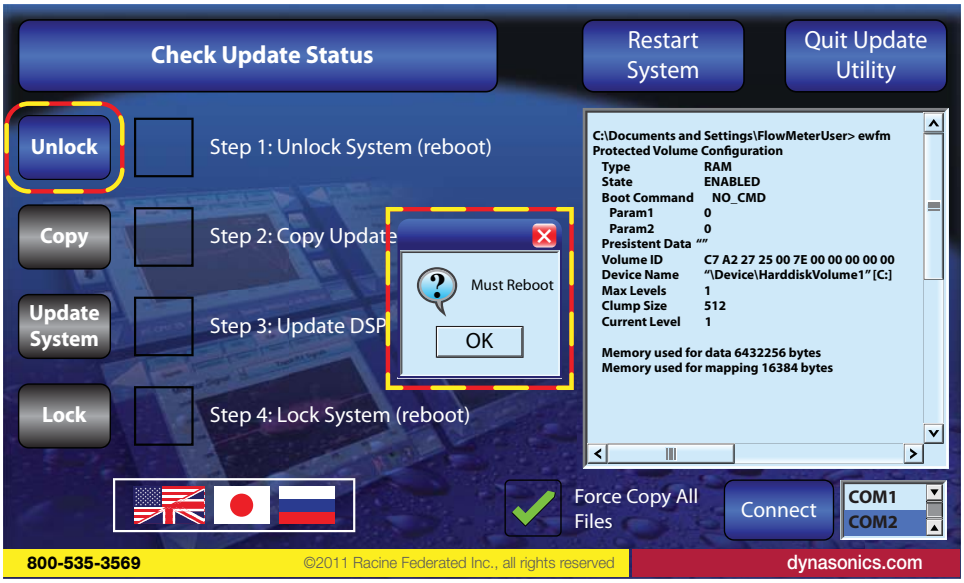
7. From the System screen select the Update page (System ► Update).
8. Press the "Quit Meter to Manage / Update" button.



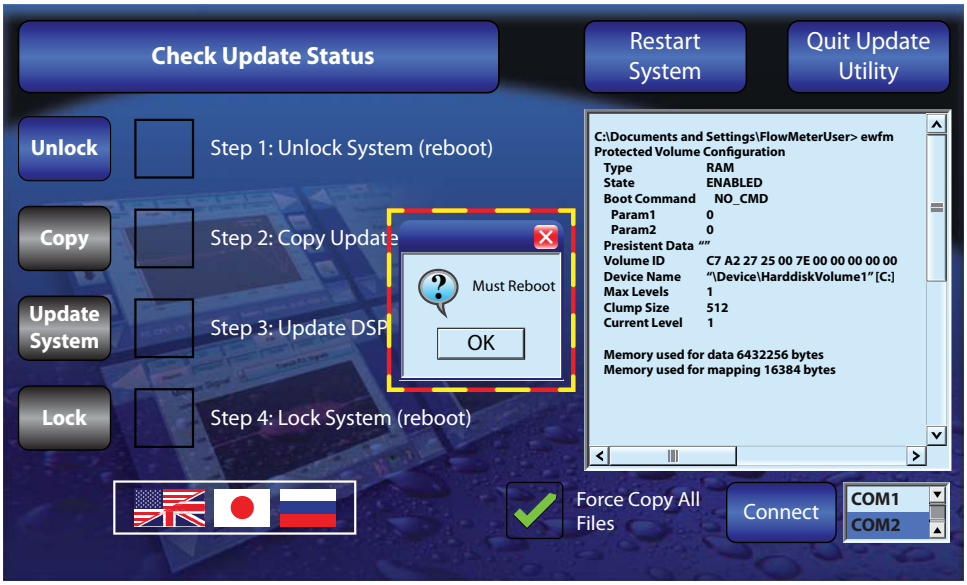
9. Press the “Start Updater” button.



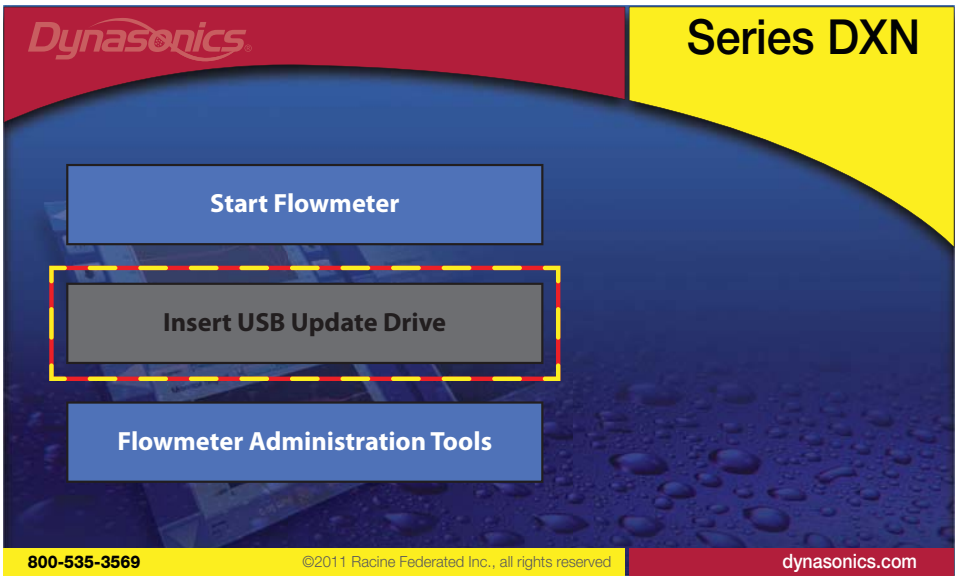
10. Press the “Unlock” button (Step 1: Unlock System (Reboot)



11. There will be a small panel in the center of the screen asking if it is OK to reboot. **Remove the thumb drive** and then press the "OK" button

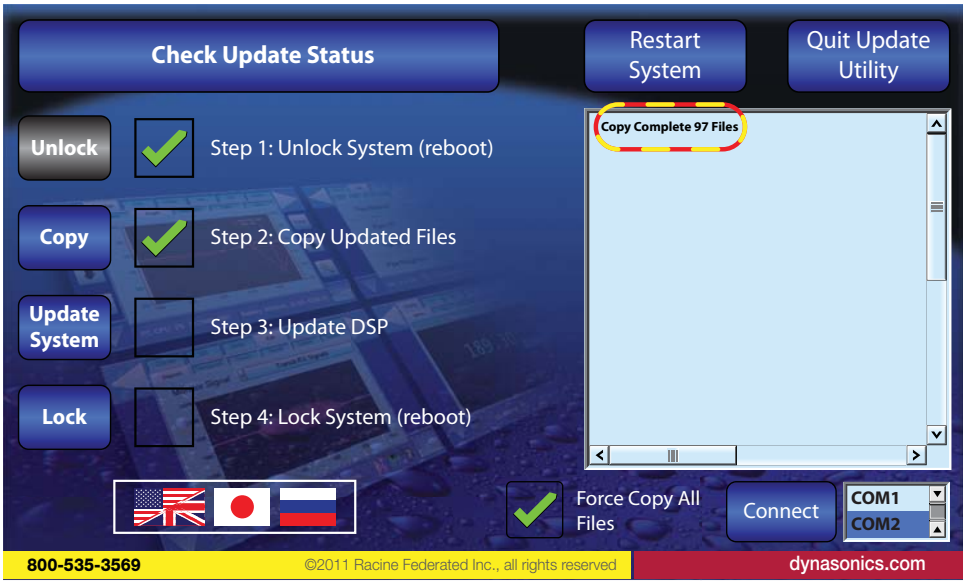


12. After the reboot there will be a screen with a grayed out button that says "Insert USB Update Drive". When the update drive is inserted the grayed out button will change to "Start Updater". Press the "Start Updater" button.



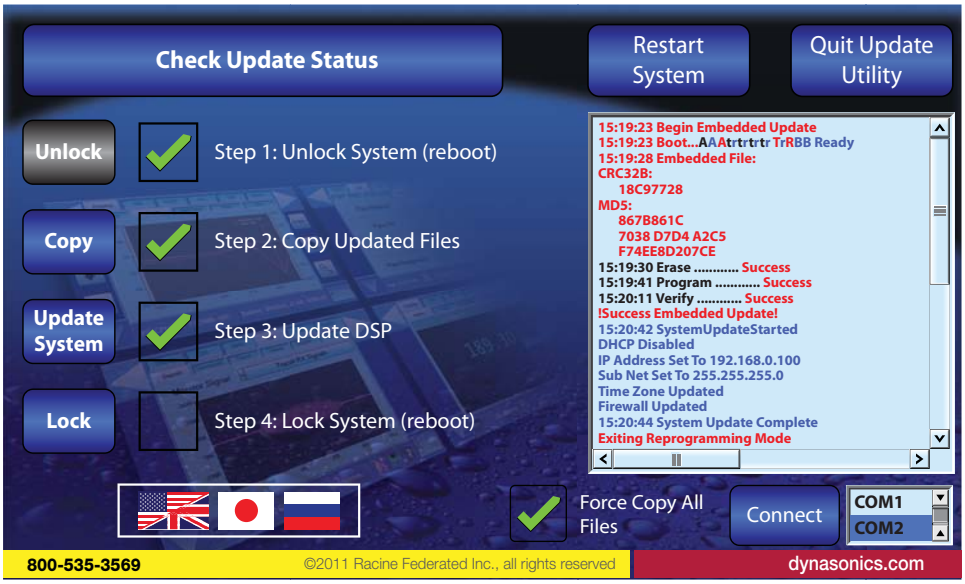
13. The meter should now be back on the update screen. Press “Copy” (Step 2: Copy Updated Files).

When the copy process is complete there will be a green ✓ in the “Copy” box.



There should also be a text message in the message area to the right that says "Copy Complete xx Files" where xx represents some number of files.

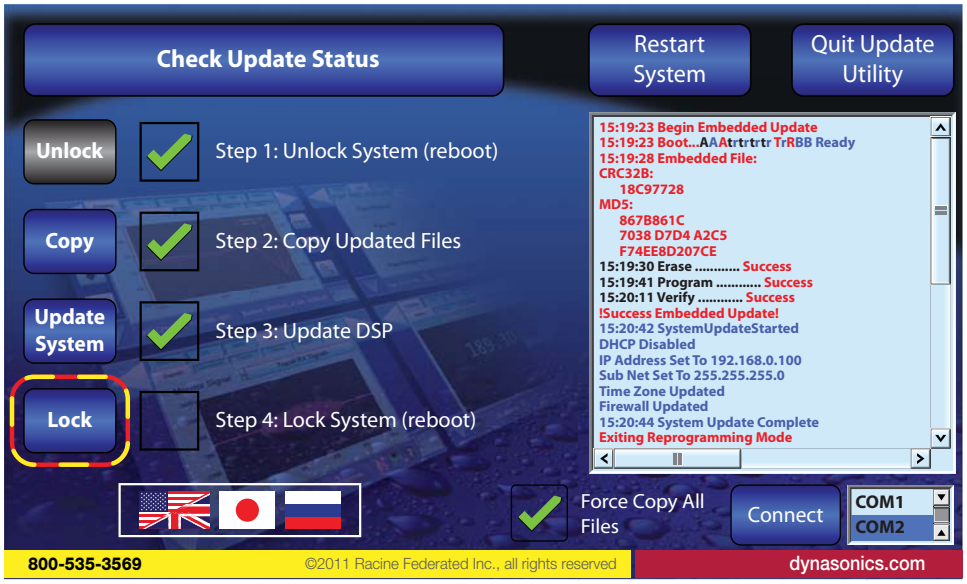
14. Press "Update System" (Step 3: Update System). The text area to the right will show a series of status messages that will end with "! Successful Embedded Update !" ... "Exiting Reprogramming Mode".



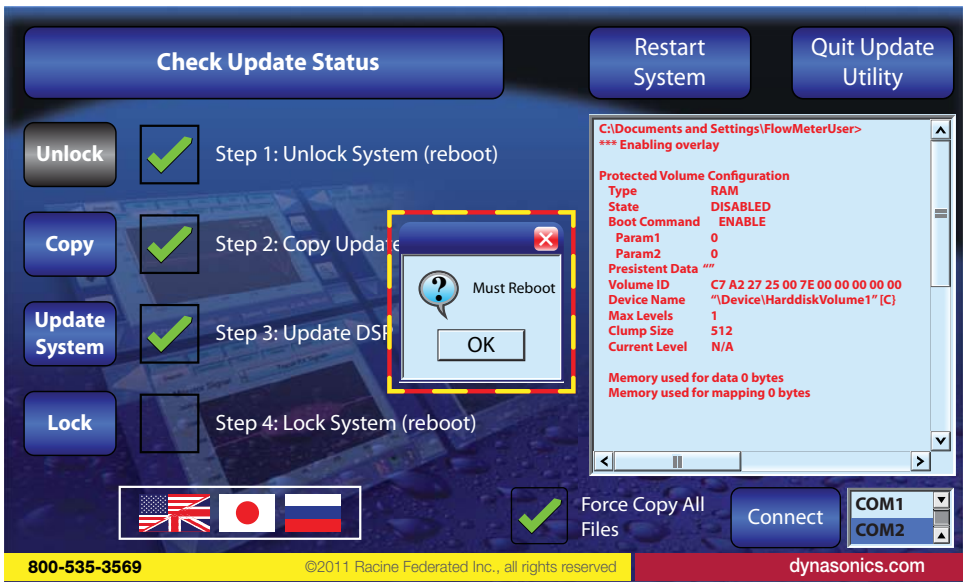
NOTE: *If the process "hangs-up" press the "Update System" button a second time which should clear the hang.*

NOTE: *The process may take a few minutes to complete. When the process is complete the scroll bars in the message area should be used to verify that the updating process has terminated with the "**!Successful Update!**" ... " **Exiting Reprogramming Mode**".*

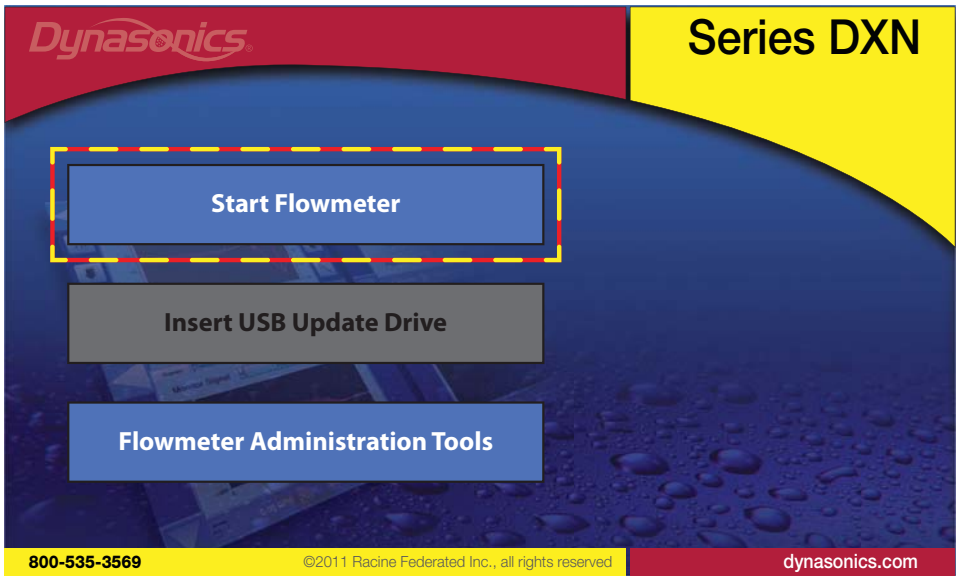
15. Press the “Lock” (Step 4: Lock System (Reboot). A short process will run again with text filling the text area.



16. At the conclusion of the process the “OK” to reboot will appear on the screen. At this point **<u>remove the thumb</u>** drive and then press “OK”



The meter will reboot again and show the start-up screen again. This reboot will use a more “Windows” like process and requires more time for completion. When the reboot is complete the meter should return to the “Start Screen”.

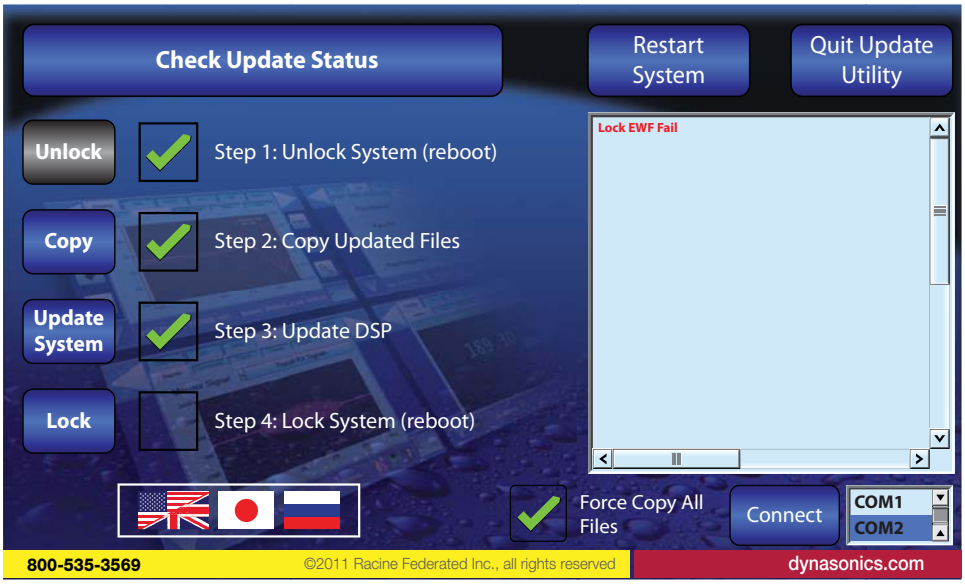


QUICK BOOT

It is highly recommended to configure the meter to use the "Quick Boot" process as described in step 17.

NOTE: *If the thumb drive is not removed before the "OK" button is pressed, the unit may "lock-up". The error message "Lock EWF Fail" may also appear in the text area. Remove the thumb drive When the meter returns to the screen that had the grayed out "Insert USB Update Drive" press the "Start Flow meter" button to resume normal operations.*

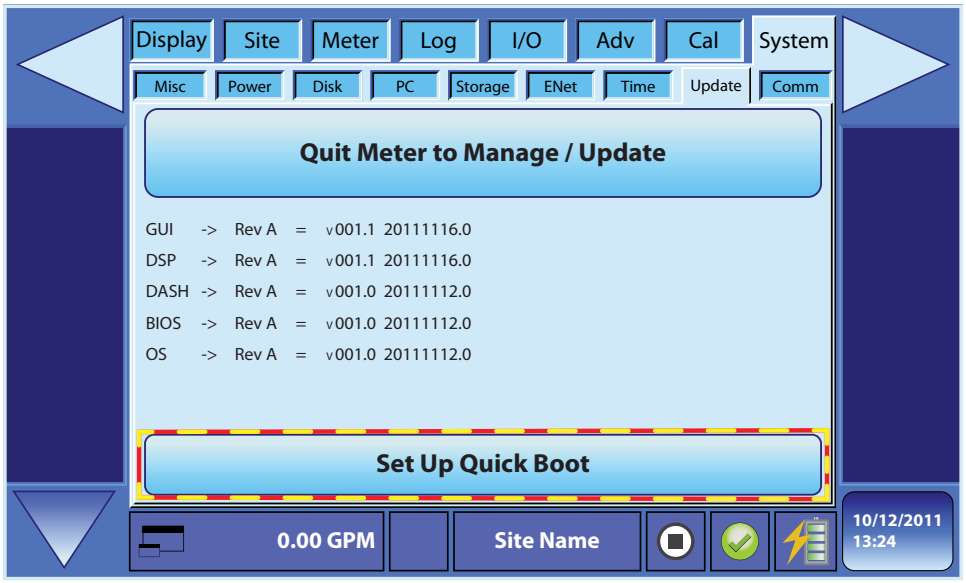
See the last page for additional instruction on clearing a "lock-up"



When the thumb drive is removed the device may continue on to a system reboot but hang at the "Dynasonics" splash screen.

This condition will require a "Hard" reboot by pressing and holding the main power button until the unit turns off. When the power button is pressed again the meter should start normally.

17. To enable "Quick Boot" from the main screen select (System ► Update) and then click on "Set Up Quick Boot".



The application will close, reverting to the system menu. Press "Start Flow Meter" again, and the unit will enter a hibernation process and shutdown.

On the next power up, the unit will be in "Quick Boot" mode

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- **Digital Certificates.** The software uses digital certificates. These digital certificates confirm the identity of Internet users sending X.509 standard encrypted information. The software retrieves certificates and updates certificate revocation lists. These security features operate only when you use the Internet.

- **Auto Root Update.** The Auto Root Update feature updates the list of trusted certificate authorities. You can switch off the Auto Root Update feature.
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    - New versions of the player; and

    - Codecs if your device does not have the correct ones for playing content. You can switch off this feature. For more information, go to:
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ELECTRICAL SYMBOLS					
Function	Direct Current	Alternating Current	Earth (Ground)	Protective Ground	Chassis Ground
Symbol					

The 24 volt DC power converter and 12 volt auto-style power cord connect to the 3-pin socket connection located on the back of the enclosure. A fully charged battery will provide up to 9 hours of continuous operation before recharging will be necessary.

At that point, the meter will only operate a short time more until it automatically turns itself off.

If the DXN is to be used for extended periods of operation, the 24 VDC line power converter or the 12 V auto-style converter can remain connected indefinitely.

To charge the internal Lithium-Ion Smart battery, apply power, utilizing the enclosed 24 VDC line power converter or auto style power cord, to the DXN for a period of 4-24 hours. The DXN has an integral charging circuit that prevents overcharging. The instrument can be permanently connected to AC line power without damaging the flow meter or the battery.

The Lithium-Ion Smart battery is "maintenance free", but it still requires a certain amount of attention to prolong its useful life. To obtain the greatest capacity and longevity from the battery, the following practices are recommended:

- When charging or using external power, allow for airflow to the instrument.
- The DXN battery management circuitry will not allow the battery to become "over-charged".
- The lithium-ion battery is rated for 300 cycles, but may last much longer than that. Cycle counts are shown in the system menu.
- If the DXN is stored for prolonged periods of time, recharge every 6 months and recharging before use is recommended.
- If the DXN is stored for prolonged periods of time, store at room temperature. Extended exposure above 40 °C can degrade battery life.
- Do not expose unit to temperatures beyond those specified.
- Battery should only be replaced by authorized personnel.
- In the unlikely event that smoke, abnormal noise, or strange odor is present, immediately power off the DXN and disconnect all power sources. Report the problem to your device provider immediately.

Use wiring practices that conform to local codes (National Electric Code® Handbook in the USA). Use only the power converters that have been supplied with the DXN flow meter. The ground terminal, if present on the converter, is mandatory for safe operation.

CAUTION: Any other wiring method may be unsafe or cause improper operation of the instrument. It is recommended not to run line power with other signal wires within the same wiring tray or conduit.

NOTE: *This instrument requires clean electrical line power. Do not operate this unit on circuits with noisy components (i.e. fluorescent lights, relays, compressors, variable frequency drives, etc.)*

The DXN can be operated from a 10-15 VDC source, using the included auto-style power cord, as long as it is capable of supplying at least 40 watts – observe proper polarity. Note that extended operation on an automotive supply could substantially reduce the automotive battery.

SAFETY INSTRUCTIONS

Warning - The Internal battery pack should only be replaced by an authorized Dynasonics service representative. Please contact your product and/or service provider for internal battery replacement service.

Important Safety & Usage Instructions. Read these safety instructions carefully.

1) Read all cautions and warnings on the equipment.
2) Place this equipment on a reliable surface when installing. Dropping it or letting it fall may cause damage.
3) Make sure the correct voltage is connected to the equipment.
4) For puggable equipment, the socket outlet should be near the equipment and should be easily accessible.
5) If equipment has reached its end of life, please recycle properly.
6) Disconnect this equipment from the A/C outlet before cleaning it. Use a moist cloth. Do not use liquid or spray detergent for cleaning.
7) To fully disengage the power to the unit, disconnect the power from the AC outlet.
8) Do not scratch or rub the screen with a hard or sharp object.
9) Never use any of the solvents, such as thinner spray-type cleaner, wax, benzene, abrasive cleaner, acid or alkaline solvent, on the display. Harsh chemicals may cause damage to the enclosure and the touch screen sensors.
10) Remove dirt with a lightly moistened cloth. Then wipe the enclosure with a soft dry cloth.
11) The fins on the enclosure are for air convection and protect the equipment from overheating.

DO NOT COVER THE OPENINGS.

12) Position the power cord so that cannot be stepped on. Do not place anything over the power cord.
13) If the equipment will not be used for a long time, disconnect it from the power source to avoid damage by transient over-voltage.
14) Never pour any liquid into openings. This may cause fire or an electrical shock.
15) Never open the equipment. There are no user serviceable parts inside. For safety reasons, the equipment should be opened only by qualified service personnel.

16) If one of the following situations arises, get the equipment checked by service personnel:
   a. The power cord or plug is damaged.
   b. Liquid has penetrated into the equipment.
   c. The equipment does not work properly, or you cannot get it to work according to the user's manual.
   d. The equipment has been dropped or damaged.
   e. The equipment has obvious signs of breakage.

WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE

In the European Union, this label indicates that this product should not be disposed of with household waste. It should be deposited at an appropriate facility to enable recovery and recycling.

For information on how to recycle this product responsibly in your country, please visit: www.racinefed.com/recycle/

ENGLISH

RESTRICTIONS OF HAZARDOUS SUBSTANCES (ROHS) DIRECTIVE

This product is compliant with RoHS Directive 2011/something/something by exemption.

Declaration of Conformity

CE - The CE symbol on your product indicates that it is in compliance with the directives of the Union European (EU).

FCC Class B - This device complies with Part 15 of the FCC Rules.

Certificates of Compliance, Test Reports, and further information is available by contacting Technical Support.

Battery Care

» A portable device should be turned off while charging. This allows the battery to reach the threshold voltage unhindered and reflects the correct saturation current responsible to terminate the charge. A parasitic load confuses the charger.

» Charge at a moderate temperature. Do not charge below freezing.

» Lithium-ion does not need to be fully charged; a partial charge is better.

» Chargers use different methods for "ready" indication. The light signal may not always indicate a full charge.

» Discontinue using charger and/or battery if the battery gets excessively warm.

» Before prolonged storage, apply some charge to bring the pack to about half charge.

K-FACTORS EXPLAINED

The K-factor (with regards to flow) is the number of pulses that must be accumulated to equal a particular volume of fluid. You can think of each pulse as representing a small fraction of the totalizing unit.

An example might be a K-factor of 1000 (pulses per gallon). This means that if you were counting pulses, when the count total reached 1000, you would have accumulated 1 Gallon of liquid. Using the same reasoning each individual pulse represents an accumulation of 1/1000 of a gallon. This relationship is independent of the time it takes to accumulate the counts.

The frequency aspect of K-factors is a little more confusing because it also involves the flow rate. The same K-factor number, with a time frame added, can be converted into a flow rate. If you accumulated 1000 counts (one gallon) in one minute, then your flow rate would be 1 GPM. The output frequency, in Hz, is found simply by dividing the number of counts (1000) by the number of seconds (60) to get the output frequency.

1000 ÷ 60 = 16.6666... Hz. If you were looking at the pulse output on a frequency counter, an output frequency of 16.666...Hz would be equal to 1 GPM. If the frequency counter registered 33.333...Hz (2 × 16.666...Hz), then the flow rate would be 2 GPM.

Finally, if the flow rate is 2 GPM, then the accumulation of 1000 counts would take place in 30 seconds because the flow rate, and hence the speed that the 1000 counts is achieved, is twice as great.

Calculating K-factors for Ultrasonic meters

Many styles of ultrasonic flow meters are capable of measuring flow in a wide range of pipe sizes. Because the pipe size and volumetric units the meter will be used on vary, it is not possible to provide a discrete K-factor. Instead the velocity range of the meter is usually provided along with a maximum frequency output.

The most basic K-factor calculation requires that an accurate flow rate and the output frequency associated with that flow rate be known.

Example 1:

Known values are:

Frequency = 700 Hz
Flow Rate = 48 GPM

1) 700 Hz × 60 sec = 42,000 pulses per min

2) $$\text{K-factor} = \frac{42{,}000 \text{ pulses per min}}{48 \text{ GPM}} = 875 \text{ pulses per gallon}$$

Example 2:

Known values are:

Full Scale Flow Rate	=	85 GPM
Full Scale Output Frequency	=	650 Hz

1) 650 Hz x 60 sec = 39,000 pulses per min

2) $$\text{K-factor} = \frac{39{,}000 \text{ pulses per min}}{85 \text{ GPM}} = 458.82 \text{ pulses per gallon}$$

The calculation is a little more complex if velocity is used because you first must convert the velocity into a volumetric flow rate to be able to compute a K-factor.

To convert a velocity into a volumetric flow, the velocity measurement and an accurate measurement of the inside diameter of the pipe must be known. Also needed is the fact that 1 US gallon of liquid is equal to 231 cubic inches.

Example 3:

Known values are:

Velocity	=	4.3 ft/sec
Inside Diameter of Pipe	=	3.068 in

1) Find the area of the pipe cross section.

$$\text{Area} = \pi r^2$$

$$\text{Area} = \pi \left(\frac{3.068}{2}\right)^2 = x\ 2.353 = 7.39 \text{ in}^2$$

2) Find the volume in 1 ft of travel.

$$7.39 \text{ in}^2 \ x\ 12 \text{ in (1Ft.)} = \frac{88.71 \text{ in}^3}{\text{ft}}$$

3) What portion of a gallon does 1 ft of travel represent?

$$\frac{88.71 \text{ in}^3}{231 \text{ in}^3} = 0.384 \text{ gallons}$$

So for every foot of fluid travel 0.384 gallons will pass.

What is the flow rate in GPM at 4.3 ft/sec?

0.384 gallons *x* 4.3 FPS *x* 60 sec (1 min) = 99.1 GPM

Now that the volumetric flow rate is known, all that is needed is an output frequency to determine the K-factor.

Known values are:

Frequency	=	700 Hz (By measurement)
Flow Rate	=	99.1 GPM (By calculation)

1) 700 Hz × 60 sec = 42,000 pulses per gallon

2) $$\text{K-factor} = \frac{42{,}000 \text{ pulses per min}}{99.1 \text{ GPM}} = 423.9 \text{ pulses per gallon}$$

Specific Heat Capacity for Water		
Temperature		Specific Heat BTU/lb °F
°F	°C	
32-212	0-100	1.00
250	121	1.02
300	149	1.03
350	177	1.05

TABLE A.1 - SPECIFIC HEAT CAPACITY VALUES FOR WATER

Specific Heat Capacity Values for Common Fluids			
Fluid	Temperature		Specific Heat BTU/lb °F
	°F	°C	
Ethanol	32	0	0.65
Methanol	54	12	0.60
Brine	32	0	0.71
Brine	60	15	0.72
Sea Water	63	17	0.94

TABLE A.2 - SPECIFIC HEAT CAPACITY VALUES FOR OTHER COMMON FLUIDS

Specific Heat Capacity BTU/lb °F								
Temperature		Ethylene Glycol Solution (% by Volume)						
°F	°C	25	30	40	50	60	65	100
-40	-40	n/a	n/a	n/a	n/a	0.68	0.70	n/a
0	-17.8	n/a	n/a	0.83	0.78	0.72	0.70	0.54
40	4.4	0.91	0.89	0.845	0.80	0.75	0.72	0.56
80	26.7	0.92	0.90	0.86	0.82	0.77	0.74	0.59
120	84.9	0.93	0.92	0.88	0.83	0.79	0.77	0.61
160	71.1	0.94	0.93	0.89	0.85	0.81	0.79	0.64
200	93.3	0.95	0.94	0.91	0.87	0.83	0.81	0.66
240	115.6	n/a	n/a	n/a	n/a	n/a	0.83	0.69

TABLE A.3- SPECIFIC HEAT CAPACITY VALUES FOR ETHYLENE GLYCOL/WATER

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